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# USSR Report

CHEMISTRY

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10 April 1986

USSR REPORT  
CHEMISTRY

## CONTENTS

## ADSORPTION

- Interaction of Chlorophyll a With Dodecanol in Adsorption  
Model System  
(T.N. Kropacheva, N.A. Mamleyeva, et al.; ZHURNAL  
FIZICHESKOY KHIMII, No 10, Oct 85)..... 1

## ANALYTICAL CHEMISTRY

- Study of Ion-Ion and Ion-Molecular Interaction in Solutions  
of Alkali and Alkaline Earth Metal Thiocyanates in  
Dimethylformamide by Infrared Spectroscopy  
(I.S. Perelygin, V.S. Osipov, et al.; ZHURNAL  
FIZICHESKOY KHIMII, No 10, Oct 85)..... 2
- Procedure for Selecting Substances with Desired Properties.  
Method of Directed Search  
(A.D. Okhotsimskiy, L.P. Filippov; ZHURNAL FIZICHESKOY  
KHIMII, No 10, Oct 85)..... 2

## BIOCHEMISTRY

- Influence of Temperature on Chemical Composition and Biological  
Activity of Peat Oxidation Products  
(G.V. Naumova, L.V. Kosonogova, et al.; KHIMIYA  
TVERDOGO TOPLIVA, No 5, Sep-Oct 85)..... 4
- Influence of Low-Frequency Hydrodynamic Oscillations on Status  
of Stabilized Cholesterol Dispersions  
(M.A. Khachatryan, N.S. Tarasova, et al.; ZHURNAL  
FIZICHESKOY KHIMII, No 10, Oct 85)..... 4

## CATALYSIS

Zeolites, New Source of Catalysts (E. Nikolskaya; GUDOK, 17 Sep 85).....	6
Influence of Iridium on Adsorption and Catalytic Properties of Applied Palladium Catalysts (G.D. Zakumbayeva, V.A. Naydin, et al.; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	8
Emission of Singlet Oxygen in Process of Aggregation of Freshly Atomized Layers of Silver on Quartz in the Presence of Oxygen (N.N. Savvin, E.S. Soloveva, et al.; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	8
Interaction of $UCl_4$ with Certain Donor Solvents (S.S. Lalayan, A.N. Kitaygorodskiy, et al.; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	9
Synthesis, Structure and Catalytic Characteristics of Vanadium Phosphates (Ya.Ya. Gedrovits, Z.A. Konstant, et al.; IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA, No 5, Sep-Oct 85).....	10

## CHEMISTRY INDUSTRY

High-Temperature High-Pressure Impulse Reactor (ZNANIYE-SILA, No 11, Nov 85).....	11
Problems and Prospects for Using Dispersed Carbon-Silicate Composite Materials in Chemical Engineering (Synopsis) (I.G. Kovzun, I.T. Protsenko, et al.; KHIMICHESKAYA TEKHNOLOGIYA, No 5, Sep-Oct 85).....	13
Gorbachev Calls for Use of Imported Heavy Equipment (N. Lemayev; SOTSIALISTICHESKAYA INDUSTRIYA, 1 Dec).....	24
Estonian Plant Recovers Sulfur Products from Air (V. Proskura; SOTSIALISTICHESKAYA INDUSTRIYA, 23 Nov 85).....	26
Experimental Testing of Gas Cryogenic Engine with Staged Regulation of Cooling Capacity (A.V. Smirnov, V.M. Myasnikov, et al.; KHIMICHESKOY I NEFTYANOYE MASHINOSTROYENIYE, No 10, Oct 85).....	27
Corrosion Resistance of Materials in Production of Synthetic Acids (Yu.L. Kosmenko, I.I. Baydin; KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE, No 10, Oct 85).....	28

## COAL GASIFICATION

Survey of Kansk-Achinsk Fuel Energy Complex (V. Krutikov; ZNANIYE-SILA, No 10, 1985).....	29
Coal Mining Association Exceeds Plan by Two Months (A. Maltsev; SOTSIALISTICHESKAYA INDUSTRIYA, 5 Nov 85)....	38
Properties of Coal from Agulak Deposit and Possibility of Producing Mellitic Acid from it (K.A. Sartova, Sh.S. Sarymsakov, et al.; KHIMIYA TVERDOGO TOPLIVA, No 5, Sep-Oct 85).....	39
Hydrogenization of Brown Coal from Kansk-Achinsk Basin in Presence of Small Quantities of Molybdenum Catalyst (A.A. Krichko, M.Ya. Shpirt, et al.; KHIMIYA TVERDOGO TOPLIVA, No 5, Sep-Oct 85).....	40
Interrelationship of Structural-Chemical Parameters of Brown Coal with Basic Hydrogenation Process Characteristics (I.B. Krichko, T.M. Krenkova; KHIMIYA TVERDOGO TOPLIVA, No 5, Sep-Oct 85).....	40
Dynamics of Gas Formation During Gasification of Coal in a Fluidized Bed under Pressure (T.V. Nikitina, I.I. Chernenkov; KHIMIYA TVERDOGO TOPLIVA, No 5, Sep-Oct 85).....	41
Some Problems on Mechanism of Catalytic Hydrogenation of Carbon Black (G.I. Ushakova, V.K. Shiryaev; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	42

## ELECTROCHEMISTRY

Influence of Heating in Argon on Properties of Palladium Electrode Catalyst (N.D. Stepina, G.D. Vovchenko, et al.; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	43
Localized Electron Reaction Kinetics on Solution of Solid Dielectrics (Yu.Ye. Tiliks, L.K. Kants, et al.; IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA, No 5, Sep- Oct 85).....	43
Use of Spin Probe Method to Study Paramagnetism of Carbon Fibers (G.A. Grigorev, I.G. Makarov, et al.; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	44

Space-Time Modulation of Light by Organic Polymer Photo-conductor -- Liquid Crystal Structure (V.S. Mylnikov, Ye.A. Morozova, et al.; ZHURNAL TEKHNICHESKOY FIZIKI, No 4, Apr 85).....	44
--	----

## FERTILIZERS

Computer Data Used to Improve Harvest in Siberia (EKONOMICHESKAYA GAZETA, No 43, Oct 85).....	46
Use of Trace Elements in Vegetable Farming in Sheltered Soil (O.A. Tchuprikova, R.S. Ryabykh, et al.; AGROKHIMIYA, No 9, Sep 85).....	47
Influence of Increasing Doses of Mineral Fertilizer, Liquid and Solid Manure on Resistance of Barley to Root Rot (V.G. Mineyev, N.A. Belousova, et al.; AGROKHIMIYA, No 9, Sep 85).....	48
Use of Nitrogen Fertilizers and Regulations of Nitrate Content in Plants (V.M. Semenov, K. Knop, et al.; AGROKHIMIYA, No 9, Sep 85).....	48
Effectiveness of Mechanically Activated Phosphorites on Soddy-Podzolic Soil (F.V. Yanishevskiy, V.A. Kozhemyachko, et al.; AGROKHIMIYA, No 9, Sep 85).....	49
Improving Seed Treatment Quality. (T.T. Strashnova; ZASHCHITA RASTENIY, No 8, Aug 85).....	50

## FREE RADICALS

Low Temperature Transformation of Hydrocarbons in Presence of Hydrogen Peroxide on Oxide Catalysts (A.M. Elchyan, G.I. Grigoryan, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, Nov 85).....	51
---	----

## INORGANIC COMPOUNDS

New Ceramic Insulators (V. Masin; NAUKA I TEKNIKA, No 8, Aug 85).....	52
Dependence of Specific Surface Area of Porous Silicon on Parameters of Anodic Treatment and High-Temperature Annealing (V.P. Bondarenko, A.M. Dorofeyev, et al.; POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA, No 10, Oct 85).....	53

## NITROGEN COMPOUNDS

- Nitric Oxides in Fuel Combustion Products and in Free Air  
(I.Ya. Sigal; *KHIMICHESKAYA TEKHOLOGIYA*, No 5,  
Sep-Oct 85)..... 55

## ORGANOMETALLIC COMPOUNDS

- Method for Synthesizing Orthoquinone Compounds  
(V. Goldanskiy; *IZVESTIYA*, 13 Sep 85)..... 63
- Sixth European Conference on Metalloorganic Chemistry  
(*SOVETSKAYA LATVIYA*, 18 Sep 85)..... 65
- Study of Solid-Phase Dissolution of Iron Acetylacetonate  
by Gamma Resonance  
(I.G. Gusakovskaya, S.I. Pirumova, et al.; *ZHURNAL  
FIZICHESKOY KHIMII*, No 10, Oct 85)..... 67

## ORGANOPHOSPHORUS COMPOUNDS

- Effect of Structure of Dibasic Phosphororganic Compounds on  
Their Extraction Ability  
(A.M. Rozen, A.S. Nikiforov, et al.; *DOKLADY AKADEMII  
NAUK SSSR*, No 1, 1985)..... 68

## PESTICIDES

- Effect of Herbicide Rosaline on Photochemical Activity of  
Chloroplasts of Resistant and Nonresistant Plants  
(N.P. Loy; *AGROKHIMIYA*, No 9, Sep 85)..... 69
- Effectiveness of Sodium Trichloroacetate as Function of  
its Location in Soil  
(N.N. Martynovitch; *AGROKHIMIYA*, No 9, Sep 85)..... 70
- Laboratory Control of Chemicals in Agriculture  
(P.I. Primak; *ZASHCHITA RASTENIY*, No 9, Sep 85)..... 70
- Biological Methods of Plant Protection in Belorussia  
(V.F. Samersov, V.I. Sidlyarevich; *ZASHCHITA RASTENIY*,  
No 9, Sep 85)..... 71

## PETROLEUM PROCESSING TECHNOLOGY

- Tyumen Oil and Gas Equipment Shortages  
(Yu. Belanov, V. Zhilyakov; *SOTSIALISTICHESKAYA  
INDUSTRIYA*, 5 Nov 85)..... 72

New Wells on Yamal Peninsula Produce Oil and Gas (A. Trutnev; SOTSIALISTICHESKAYA INDUSTRIYA, 20 Nov 85)...	76
Tatar Oil Production Above Plan (A. Mannanov; SOTSIALISTICHESKAYA INDUSTRIYA, 21 Nov 85)..	78
Natural Gas Used for Truck Fuel in Kazan (U. Bogdalov; SOTSIALISTICHESKAYA INDUSTRIYA, 23 Nov).....	79
Universal [Blowout] Preventors for Petroleum and Gas Fields with High H <sub>2</sub> S and CO <sub>2</sub> Content (N.G. Kurbanov, B.O. Frenkel, et al.; KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE, No 10, Oct 85).....	80
POLYMERS AND POLYMERIZATION	
Polymer Replacement for Lead in Batteries (A. Fin; ZNANIYE-SILA, No 10, 1985).....	81
Interaction of Carbon Fibers of Various Types with Chlorine (V.D. Ivin, A.A. Malkov, et al.; KHIMIYA TVERDOGO TOPLIVA, No 5, Sep-Oct 85).....	85
Kinetics of Adhesive Interaction of Polyolefins and Metal in Contact Thermooxidation. Part 6. Effects of Adsorbent Fillers on Adhesive Interactions (M.M. Kalnin, L.Ya. Malers; IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA, No 5, Sep-Oct 85)...	85
Kinetics of Adhesive Interaction of Polyolefins and Metal in Contact Thermooxidation. Part 7. Kinetic Description of Resistance to Peel-Off of Adhesive Filled-Polyethylene- Steel Laminates (M.M. Kalnin, L.Ya. Malers; IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA, No 5, Sep-Oct 85)...	86
Influence of Composition of Reinforcing Chemical Fibers on Destruction and Fire-Proofing of Composite Materials (L.G. Panova, S. Ye. Artenenko, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	87
Influence of Structure of Benzophenone Derivatives on Effective- ness of Photoinitiated Cross Linking of Polyethylene (P.V. Zamotayev, V.M. Granchak, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	87
Influence of Aerosil Surface on Energetic Interaction with PVC and Mechanical Properties (S.M. Yushkova, V.V. Guzeyev, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	88



Influence of Various Factors on Kinetics of Consumption of Ethylene in Polymerization on the Surface of Kaolin Particles Treated with Organoaluminum Compounds (N.N. Vlasova, P.Ye. Matkovskiy, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	88
Specifics of Elementary Stages of Radiation Polymerization of Monomers on the Surface of Solids. Radical Polymerization in Systems with Weak Adsorption Bonds (M.A. Bruk, S.A. Pavlov, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	89
Electrochemical Reductional Destruction of Some Carbochain Polymers (G.S. Shapoval, A.A. Pud, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	90
Photoinitiation in Long-Wave Photooxidation of Polyamides (L.M. Postnikov, Ye. V. Vichutinskaya, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	90
Automated Control and Maintenance of Molding and Winding Machines (V.V. Klyuchnikov, Yu.V. Dumchenko, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	91
Production of Ultrathin Fibers from Polymer Mixtures (N.A. Shitov, G.I. Timofeyeva, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	91
Polymerization of Tetrahydrofuran Initiated by Acetic Anhydride and $SbCl_5$ (S.A. Ivanova, T.I. Samsonova, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	92
High-Speed Formation of Polyester Fibers (V.E. Geller, B.N. Averkiyev; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	92
Performance Characteristics of Polypropylene Fibers Prepared with Mixtures of Soviet Nontoxic Stabilizers (A.A. Yefimov, V.P. Kolomytsyn, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	93
Effects of Spinning on Nickel-Treated Nitron Fibers (D.N. Akbarov, T.N. Ovchinnikova, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	93
Improvements in Heating Machines for Chemical Fiber Bands (O.G. Korovitsyn, V.I. Forost, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	94

Corrosion Resistance of Construction Materials in Working Environment of Polypropylene Production (L.A. Vericheva, L.V. Demidova, et al.; KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE, No 10, Oct 85).....	94
--	----

Mechanism of Laser Cracks Orientation in Transparent Polymers (S.V. Kondratov, N.F. Polipetskiy, et al.; ZHURNAL TEKHNIЧЕСКОY FIZIKI, No 4, Apr 85).....	95
--	----

## RADIATION CHEMISTRY

New Radium Detector (KHIMIYA I ZHIZN, No 6, June 85).....	96
--	----

Bombardment of Carbon-Pyroceramic Surface with Low-Energy He <sup>+</sup> -Ions; Ion Implantation and Subsequent Thermal Desorption of Atoms (M.Yu. Gerchikov, A.M. Panesh, et al.; POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA, No 10, Oct 85).....	99
--	----

Study of Ion-Bombarded GaAs Layers by Photoluminescence and Hall-Effect Methods (V.A. Bykovskiy, A.G. Bychkov, et al.; POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA, No 10, Oct 85).....	100
--	-----

Electron Paramagnetic Resonance Spectrum of Silver Atoms in Gamma Irradiated Zeocar-2 (G.M. Popovich, N.P. Mikulshina, et al.; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	101
---	-----

Diffusion of Tritium in Lithium-Borate Glass (A.A. Khodyakov, V.L. Bogdanov, et al.; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	102
--	-----

Complex Dielectric Permeability and Dielectric Relaxation of Heavy Water Along its Curve of Existence (O.A. Nabokov, Yu. A. Lyubimov; ZHURNAL FIZICHESKOY KHIMII, No 10, Oct 85).....	102
--	-----

Photostimulated Exchange of Uranyl Oxide in Aqueous Solutions (S.A. Gaziyeu, N.G. Gorshkov, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, Nov 85).....	103
--	-----

Plasma Treatment of Seeds Ineffective in Disease Control (S.L. Tuyterev, A.G. Kronberg, et al.; ZASHCHITA RASTENIY, No 8, Aug 85).....	103
--	-----

## RUBBER AND ELASTOMERS

Development of USSR Rubber Industry (V. Nikandrov, G. Sakhapov; SOTSIALISTICHESKAYA INDUSTRIYA, 12 Sep 85).....	104
---	-----

Macrokinetics of Structuring of Low-Molecular Weight Organo-silicon Rubbers (A.Ya. Malkin, S.G. Kulichikhin, et al.; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	106
Distribution of Sulfur in Vulcanization of Elastomer Mixtures (Yu.F. Shutilin; VYSOKOMOLEKULYARNYYE SOYEDINENIYA, No 10, Oct 85).....	106
Polyacrolein Latexes: Synthesis, Addition of Filling Agents and Formation Mechanism (Yu.V. Lukin, V.N. Bakharev, et al.; DOKLADY AKADEMII NAUK SSSR, No 1, 1985).....	107

#### WATER TREATMENT

Experimental Municipal Water System to be Expanded (I.V. Kozhinov; VODOSNABZHENIYE I SANITARNAYA TEKHNIKA, No 10, Oct 85).....	108
Flotation Purification of Ship-Borne Petroleum-Containing Waters (Ya.A. Karelin, V.F. Bogdanov, et al.; VODOSNABZHENIYE I SANITARNAYA TEKHNIKA, No 10, Oct 85).....	115
Intensification of Installations for Biological Purification in Sugar Production Plants (O.V. Demidov, I.A. Sidorov, et al.; VODOSNABZHENIYE I SANITARNAYA TEKHNIKA, No 10, Oct 85).....	116
Testing of Jet Separators for Concentrating Activated Sludge (B.N. Khudyakov, Yu.L. Aromatov, et al.; VODOSNABZHENIYE I SANITARNAYA TEKHNIKA, No 10, Oct 85)....	117
Automation of Monitoring of Sulfide Ions in Waste Waters (V.D. Eristavi, N.G. Makharoblishvili, et al.; SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR, No 2, May 85).....	117

#### WOOD CHEMISTRY

Comparative Analysis of Methods for Determination of Sulfuric Acid and Aluminum Sulfate in Settling Tanks at Viscose Facility (L.V. Matveyko, T.N. Bogoslovskaya, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	118
Composition of Hemicellulose Dissolved in Mercerization Fluid of Viscose Facilities (V.S. Ivanova, E.Z. Kipershlak, et al.; KHIMICHESKIYE VOLOKNA, No 5, Sep-Oct 85).....	118

MISCELLANEOUS

Book: Quantum Chemistry under Conditions of Deep Cold  
(KHIMIYA: KVANTOVAYA KHIMIYA V OBLASTI GLUBOKOGO  
KHOLODA, No 10, Oct 85)..... 120

Simultaneous Action of Two Acoustical Oscillation Frequencies  
on Rate of Acousticochemical Reactions  
(A.F. Dmitriyeva, M.A. Margulis; ZHURNAL FIZICHESKOY  
KHIMII, No 10, Oct 85)..... 123

## ADSORPTION

UDC 541.183:547.979.7

### INTERACTION OF CHLOROPHYL a WITH DODECANOL IN ADSORPTION MODEL SYSTEM

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 3 Jul 84) pp 2631-2633

KROPACHEVA, T.N., MAMLEYEVA, N.A. and NEKRASOV, N.I., Chemistry Faculty,  
Moscow State University imeni M. V. Lomonosov

[Abstract] A study is made of the influence of dodecyl alcohol on association of chlorophyll a adsorbed on a nonpolar surface. The results convincingly prove disaggregation of chlorophyll on a C-16 surface when dodecanol is introduced to the adsorption layer. Varying the concentrations of the substances in the adsorbed layer can yield systems with various degrees of aggregation of the pigment. The disaggregating effect on chlorophyll adsorbed on a nonpolar surface may be achieved with other amphiphilic substances whose polar groups can associate with the pigment as well. Figures 3; references 8: 5 Russian, 3 Western.  
[220-6508]

UDC 535.343+532.74

STUDY OF ION-ION AND ION-MOLECULAR INTERACTION IN SOLUTIONS OF ALKALI AND ALKALINE EARTH METAL THIOCYANATES IN DIMETHYLFORMAMIDE BY INFRARED SPECTROSCOPY

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 21 Dec 83) pp 2455-2459

PERELYGIN, I.S., OSIPOV, V.S. and GRYAZNOV, S.I., Order of Lenin Aviation Institute imeni Sergo Ordzhonikidze, Ufa

[Abstract] A study is made of ion-ion and ion-molecular interactions occurring in solutions of the thiocyanates of lithium, sodium, potassium, calcium and barium in DMF. The absorption bands of the polyatomic  $\text{SCN}^-$  anion in the spectra of the solutions studied are presented. An increase in the frequency of all oscillations of excited anions indicates that their interaction with the metal cations in the solutions studied occurs through the nitrogen atom and leads to the formation of contact ion pairs or triplets in the case of calcium and barium. The shift in position of the bands is explained by interaction of DMF molecules with free cations and with cations included in the ionic associates. Calculated and experimental results agree well. Figures 4; references 13: 7 Russian, 6 Western.  
[220-6508]

UDC 541.66

PROCEDURE FOR SELECTING SUBSTANCES WITH DESIRED PROPERTIES. METHOD OF DIRECTED SEARCH

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 20 Dec 83) pp 2507-2510

OKHOTSIMSKIY, A.D. and FILIPPOV, L.P., Physics Faculty, Moscow State University imeni M. V. Lomonosov

[Abstract] The purpose of this work was to solve the problem of creating methods of selection of substances with desired properties as applicable to liquids and gases. The approach discussed is not based on simply running through a list of substances, but rather prediction of the properties of

a substance based on its structural formula. The development of such methods will facilitate the introduction of large numbers of new substances to planning-design and technological practice, allowing the recommendation of new heat transfer media and cooling agents, and optimization of processes in chemical technology. Quantitative description of thermodynamic properties requires the knowledge of three initial parameters: the critical molar volume, critical temperature and criterion of thermodynamic similarity. Equations are presented for determination of the macroscopic properties of substances based on their structural formulas, forming the foundation for methods of prediction of the properties of unassociated substances. A future publication will analyze a program, the input parameters of which are specific properties of substances of practical importance. Such programs, functioning on the basis of the directed search algorithm presented in this article, can be directly used in the search for new cooling agents. Figure 1; references 7 Russian. [220-6508]

UDC 66.093:553.93

INFLUENCE OF TEMPERATURE ON CHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITY OF  
PEAT OXIDATION PRODUCTS

Moscow KHIMIYA TVERDOGO TOPLIVA in Russian No 5, Sep-Oct 85 (manuscript  
received 9 Aug 84) pp 39-43

NAUMOVA, G.V., KOSONOGOVA, L.V., OVSYANNIKOVA, N.A. and RAKHTEYENKO, T.S.,  
Institute of Peat, Belorussian Academy of Sciences

[Abstract] A study was made of the influence of temperature on the yield of the chemical composition and biological activity of products of the oxidation of peat. Oxidative destruction was performed on peat with 5 percent decomposition in an autoclave in a batch process on an aqueous-alkaline suspension of peat: 100g peat, 40g NaOH, 2,000 ml H<sub>2</sub>O. In the temperature interval from 30 to 210 °C oxidation of peat in the temperature interval selected resulted in partial destruction of all its organic components, though the greatest contribution to the formation of oxidates is that of the easily hydrolyzed and humic substances. A study of the influence of oxidation temperature on biological activity indicated that the greatest biological activity is that of oxidates obtained at 90-120° C, addition of which to a nutrient medium at 0.1 percent increased the yield of yeast biomass by 20-25 percent in comparison to a control. Figure 1; references 8 (Russian).  
[174-6508]

UDC 541.64

INFLUENCE OF LOW-FREQUENCY HYDRODYNAMIC OSCILLATIONS ON STATUS OF STABILIZED  
CHOLESTEROL DISPERSIONS

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript  
received 24 Jul 84) pp 2588-2590

KHACHATURYAN, M.A., TARASOVA, N.S. and NIKOLAYEV, N.A., Second Moscow State  
Medical Institute imeni N. I. Pirogov

[Abstract] The purpose of this work was to determine the influence of the hydrophilic component of the lipoprotein on the behavior of highly dispersed



cholesterol exposed to vibration. Cholesterol-albumin buffer solution and cholesterol-sodium oleate buffer solution systems were studied. The concentration variation in light scattering of protein dispersions of cholesterol at  $n=0.077$  was determined. The resistance of dispersions to oscillation increased with increasing  $n$ , and at  $n=0.077$  the cholesterol dispersions practically did not aggregate. With  $n>1$ , particles aggregated without loss of kinetic stability. Proteins were thus found to influence the process of formation of cholesterol dispersions significantly and to be capable of increasing their stability when exposed to low-frequency oscillations. Figures 4; references 4: 2 Russian, 2 Western.

[220-6508]

## CATALYSIS

### ZEOLITES, NEW SOURCE OF CATALYSTS

Moscow GUDOK in Russian 17 Sep 85 p 4

[Article by E. Nikolskaya: "Instead of Platinum"]

[Text] In the USSR State Registry of Discoveries yet another great scientific achievement has been recorded. Scientists of the Organic Chemistry Institute of the USSR Academy of Sciences have discovered that certain zeolites (crystalline aluminosilicates), substances which modern industry produces in large quantities, may successfully be substituted in the chemical industry for precious platinum and palladium, as well as nickel and chromium, the reserves of which in nature are notably scarce. Until recently it was considered that only these expensive and rare metals were suitable to serve as catalysts (accelerators) of a broad class of hydrogenation reactions. And now chemists have found that for this there is an even more convenient and accessible material.

From text books we learn that many chemical substances enter into reaction more willingly if they have an accompanying catalyst--on the side, not participating--a substance not consumed during the reaction, but which never the less stimulates the components involved in the interaction. Chemists have long studied the mechanism of this widespread phenomenon, and much about it is already clear, although there are still many unexpected aspects here.

One such unexpected aspect has been the discovery about which we are speaking. Chemists of many countries have long engaged in the search for a substitute for expensive substances used as catalysts during hydrogenation--that is, during the reaction combining hydrogen with different organic substances. They did not turn to zeolites previously, although these materials are cheap and widely used in the chemical industry. Reactions of this type are used on a large scale, by the way: they are used during the production of plastics, paints, synthetic fibers and many other materials, without which our daily life would be unthinkable.

Let us say that in order to obtain caproic fiber it is necessary to hydrogenate benzene, one of the products of petroleum refinement. If the

volumes of modern production of caprone are considered, then the economic effect from a transition to a generally accessible catalyst becomes obvious.

The advantage of using zeolites becomes particularly notable when it involves the purification of raw material for production of various types of fuel. In order to eliminate unnecessary admixtures from the final product and thus make it less harmful for the environment, it is necessary to resort to hydrogenation. Combustible fuel on the planet is produced today in the hundreds of millions of tons and, consequently, inexpensive catalysts are very necessary here also.

Practically no branch of the economy could do without plastics today. But no matter what method is used or what original material the product is produced from, at some stage, unavoidably, the process of hydrogenation is used. And that means again that stimulators for this reaction are required.

And furthermore, zeolites as substitutes for traditional catalysts are extremely necessary for the paint and varnish industry, making analine dyes. They wait impatiently on enterprises manufacturing polyethylene. They are finding use also in many other branches.

What are these long awaited substitutes for the catalysts-grandeess?

"Tseolitos" in Greek means "boiling rock." This is what geologists called the porous rocks discovered near volcanos, able to precipitate and absorb water and other substances. These unusual rocks were formed as a result of complex chemical processes, occurring in the Earth's crust. They long ago used it in laboratories and in industrial enterprises for cleansers, driers and gas separators. Initially, natural zeolites were used, then they began to be synthesized, including some which are not found in nature. In other words, the possibility of obtaining substances with given properties appeared.

As catalysts or catalyst components they are used in many chemical processes, in particular, during cracking and hydrocracking of petroleum. But their ability to stimulate hydrogenation reactions was apparent first.

Specialists are considering the practical aspects of this discovery which have not been surveyed. No less important is its scientific significance. The discovered property of zeolites significantly broadens the concept of catalytic action of solid bodies, and creates a reference for developing new directions in research in organic chemistry.

12318

CSO: 1841/26

UDC 541.128

INFLUENCE OF IRIIDIUM ON ADSORPTION AND CATALYTIC PROPERTIES OF APPLIED  
PALLADIUM CATALYSTS

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript  
received 23 Dec 83) pp 2440-2443

ZAKUMBAYEVA, G. D., NAYDIN, V.A., DOSTIYAROV, A.M. and YEGIZBAYEVA, R.I.,  
Institute of Organic Catalysts and Electrochemistry, KaSSR Academy of Sciences,  
Alma-Ata

[Abstract] A study is reported of the influence of small quantities of iridium on the adsorption of hydrogen and oxygen and the catalytic activity of applied Pd-Ir catalysts in hydrogenation. Application of Pd-Ir catalysts by soaking a carrier in a mixture of solutions of the metal compounds forms a complex chemical structure on the surface of the carrier which can be reduced to metal clusters. A nonadditive change in specific adsorption of hydrogen and its heat of adsorption is observed on catalysts applied to  $\text{SiO}_2$  and  $\text{MgO}$ . The formation of firm palladium-iridium metal clusters decreases the selectivity of the catalysts, while weaker clusters increase its selectivity. The heat of adsorption of  $\text{O}_2$  on the surface of Pd-Ir catalysts is 70-120 kJ/mol lower than on monometallic catalysts. Figures 3; references 8: 6 Russian, 2 Western.  
[220-6508]

UDC 541.128

EMISSION OF SINGLET OXYGEN IN PROCESS OF AGGREGATION OF FRESHLY ATOMIZED  
LAYERS OF SILVER ON QUARTZ IN THE PRESENCE OF OXYGEN

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript  
received 16 Dec 83) pp 2464-2466

SAVVIN, N.N., deceased, SOLOVEVA, E.S. and MYASNIKOV, I.A., Scientific  
Research Physical-Chemical Institute imeni L. Ya. Karpov, Moscow

[Abstract] An attempt was made to detect emission of active particles upon interaction of oxygen molecules with the surface of freshly atomized layers

of silver on quartz. The system  $O_2$ -Ag/SiO<sub>2</sub> was studied by a semiconductor method allowing identification and quantitative determination of various active particles in the reaction volume. Experiments were performed in a one-piece quartz reactor vessel consisting of two thermostatted chambers. The results indicate that among the active particles flying from the surface of the silver in the presence of oxygen in the process of metal aggregation are molecules of electron-excited oxygen, namely singlet oxygen. In the process of aggregation of silver atoms on quartz in the presence of  $O_2$ , sufficient energy is liberated to convert oxygen molecules to the electron-excited state. Figures 2; references 9: 8 Russian, 1 Western. [220-6508].

UDC 541.49

#### INTERACTION OF $UCl_4$ WITH CERTAIN DONOR SOLVENTS

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 26 Dec 83) pp 2516-2520 .

LALAYAN, S.S., KITAYGORODSKIY, A.N., MINEVICH, V. Ya., TURSUNOV, Kh. T., FUSHMAN, E.A., SHUPIK, A.N. and KHVOSTIK, G.M., USSR Academy of Sciences, Institute of Chemical Physics, Moscow

[Abstract] A study was made of the initial stage of formation of active centers in complexes of salts of the lanthanides and actinides with donor molecules, the interaction of metal salts with certain oxygen-containing molecules. The objects of the study were uranium, tetrachloride and frequently used components of catalytic systems: methanol and butanol plus tetrahydrofuran. It was found that to describe the status of uranium salts in various catalytic systems one must consider processes of solvation of uranium by donor molecules, processes of self association, alcoholysis, as well as the possibility of formation of adducts of uranium compounds with various monomers, particularly acetylene monomers. Figures 4; references 12: 8 Russian, 4 Western. [220-6508]

SYNTHESIS, STRUCTURE AND CATALYTIC CHARACTERISTICS OF VANADIUM PHOSPHATES

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA in Russian No 5, Sep-Oct 85 (manuscript received 25 Mar 85) pp 529-544

GEDROVITS, Ya.Ya., KONSTANT, Z.A., KRASNIKOV, V.V., LEYTIS, L.Ya., SKOLMEYSTERE, R.A. and SHIMANSKAYA, M.V., Institutes of Inorganic Chemistry and of Organic Synthesis, Latvian SSR Academy of Sciences

[Abstract] A literature survey is presented of the synthesis, structure and catalytic properties of vanadium phosphates which covers the period 1970-1984, complemented by experimental results derived in the authors' laboratories. Vanadium is capable of forming a variety of phosphates due to its several oxidation states (V, IV, III, II) and the availability of a number of condensed phosphate anions. The physicochemical characteristics of such compounds have been extensively studied, and pertinent data for some are presented in tabular form. Two basic approaches are used in the synthesis of the vanadium phosphates: a) treatment of the oxides, salts or metallic vanadium with concentrated phosphoric acid, its solutions or polymeric melts of phosphoric acid at elevated temperatures, and b) treatment of vanadium compounds and metallic vanadium with phosphate salts (preferentially ammonium phosphate). Consideration is also accorded to structural and crystalline characteristics of the vanadium phosphates, their function as catalysts in partial oxidation of organic compounds, especially in the production of maleic anhydride and pyridine aldehydes, and kinetic mechanisms. Figures 5; references 67: 37 Russian, 30 Western.  
[251-12172]

## CHEMISTRY INDUSTRY

### HIGH-TEMPERATURE HIGH-PRESSURE IMPULSE REACTOR

Moscow ZNANIYE-SILA in Russian No 11, Nov 85 P 2

[Article under the "Economy of Resources—Law of Intensification; Courier of Science and Engineering" rubric: "'Impulse' Reactor Replaces Shop"]

[Text] Chemists try all means to increase the rate of reactions, and this includes that of industrial processes. Their main allies are temperature and pressure.

By raising the temperature to 2000 degrees Celsius and the pressure to 300-500 atmospheres, they are successful in making many "sluggish" reactions rapid. Today, reactors enabling the establishment of such, so to speak, extremal conditions have already been built. But they all have a low coefficient of useful efficiency and enormous energy losses. It is practically impossible to utilize the heat of gases heated to 2000 degrees Celsius. Not a single heat exchanger works under such conditions. Almost immediately they leave the system under the pressure of the heated gas flow and of the turbine vane.

The Petrochemical Synthesis Institute imeni A. V. Topchiev of the USSR Academy of Sciences has succeeded in constructing a reactor in which a high temperature and pressure are obtained without the input of a large amount of energy owing to the impulse compression of gases. The compression process lasts for fractions of a second, the components of the reactor fail to heat up, and, therefore, easily maintain the enormous temperature and pressure. The process takes place practically without loss of heat.

All the energy expended on compression is then successfully recovered (!) in the form of the mechanical energy of the expanding gases.

V. S. Shchipachev, senior scientific associate of the Physical-Chemical Impulse Processes Laboratory, tells about it:

"Even before the war, the Soviet physicist Academician Yu. B. Khariton used the impulse method for studying the physical properties of gases. By rapidly compressing a gas mixture in a cylinder, he succeeded in producing, admittedly for a very brief period, a pressure of several hundred atmospheres and a temperature of several thousand degrees. At first, it was used for purely scientific purposes. He did not find a practical use for it either in our

country or abroad. The fact is that everything rests upon a lubricant of a "piston-cylinder" couple. The presence of a lubricant in a chemical reactor is completely impermissible. But how can one "teach" the cylinder to work without a lubricant? It seemed to be impossible. This was the problem one had to puzzle over.

"An extremely elegant solution was found--the piston had to be made of a material which itself serves as a lubricant. Thus, a piston made of graphite was developed; 'metal-graphite' is an ideal couple.

"Openings were made in the piston of an ordinary marine diesel engine by converting it into a crank mechanism driven by an electric motor. To the diesel cylinders were added working cylinders which already had graphite pistons. This in essence is the chemical reactor. A compressed gas mixture goes into the chambers of the working cylinders. And the chemical reaction itself takes place. The cylinder with the graphite piston works ideally--does not stick and reliably contains the pressure; and the piston works smoothly and quietly.

"The graphite piston is capable of withstanding enormous pressure originating in the cylinder. The reactor, which is modest in appearance, already can replace a whole plant shop. The unit processes hundreds of cubic meters of gas per hour."

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CSO: 1841/203



PROBLEMS AND PROSPECTS FOR USING DISPERSED CARBON-SILICATE COMPOSITE  
MATERIALS IN CHEMICAL ENGINEERING (SYNOPSIS)

Kiev KHMICHESKAYA TEKHNLOGIYA in Russian No 5, Sep-Oct 85 (manuscript  
received 23 May 85), pp 3-7

[Article by I.G. Kovzun, I.T. Protsenko, F.D. Ovcharenko and I.I. Martsin of  
the Natural Dispersed Systems Department, Institute of Colloidal Chemistry  
and Hydrochemistry, USSR Academy of Sciences: "Problems and Prospects for  
Using Dispersed Carbon-Silicate Composite Materials (Synopsis)"]

[Text] The acceleration of scientific and technical progress at the current  
stage is proceeding under conditions of the depletion of many types of  
natural raw materials and material resources. Therefore, the development of  
new, highly effective composite materials and energy- and resource-saving  
technologies for obtaining them, interlinked with the problem of protecting  
the environment, is coming to the fore as one of the basic tasks of science  
and technology, now and in the near future. In conjunction with this, the  
attention of researchers and process engineers is being paid more and more to  
new types of carbon dispersed materials: carbon-silicate and other com-  
pounds grouped under the general designation of carbonized dispersed miner-  
als, or KDM.

The heat treatment processes for dispersed minerals to obtain different  
materials and products have long been used in engineering. And the processes  
of carbonization (coking) of various organic substances are widely used. In  
the course of thermal degradation transformation, such organic substances,  
under specific conditions, can form condensed polycyclic structures -- the  
basis for obtaining various types of carbon, including highly dispersed [1].  
Dispersed minerals or organic substances, separately processed at high  
temperatures, make it possible to obtain various materials with assigned  
properties. Only in the last decade it was established that carbonized  
dispersed minerals are formed when mixtures of dispersed minerals and organic  
compounds are heat treated under specific conditions [2-14]. The properties  
of KDM formed from mixtures of inorganic and organic substances, as a rule,  
sharply differ from the properties of the initial inorganic and organic  
compounds separately processed under the same conditions. It was found, for  
example, that carbon-mineral adsorbents--for all practical purposes not  
inferior to industrial activated carbon in adsorption characteristics--could  
be obtained, as well as fillers of industrial rubber mixtures, catalyst  
carriers, ceramic materials, various additives with special properties, etc.

In our view, carbon-mineral adsorbents which, unlike the natural dispersed silicates composing them, maintain the characteristic property of activated carbons--stability in water and aqueous solutions--are especially interesting. On the other hand, unlike activated carbons, they have the advantage that they don't ignite in air, since they are--as a rule--made up of from 5% to 20% activated carbon. Carbon-mineral adsorbents have one more advantage over activated carbons: the process to obtain them proceeds sufficiently fully at from 400°C to 500°C, while heating to 900°C to 950°C in an atmosphere of steam is required to obtain carbon with an activated structure. Finally, carbon-mineral adsorbents, which are made up of 80% to 95% relatively inexpensive and plentiful mineral raw materials, can successfully compete in cost with even the cheapest carbon adsorbents. Furthermore, they can be made from the waste of the adsorption purification of petroleum products and water purification in the chemical, petrochemical, and other industries. All of this makes it possible to recommend carbon-mineral adsorbents as alternatives to activated carbon primarily in water purification technology, which has great significance for environmental protection.

Carbon-mineral adsorbents have already been tested in experimental units for purifying industrial waste water. However, despite the positive results of such tests [2-15], the data obtained was insufficient for a scaled implementation of the processes to obtain carbon-mineral adsorbents and use them on a broad scale in water purification technology. In particular, this holds true for the second aspect of the problem under discussion. In connection with the steady growth in the cost of the raw material to obtain activated carbon and the sources of its reserves, the broad route to industrial implementation has been opened by the relatively inexpensive and sufficiently effective active carbon-silicate compositions. Especially since similar substances can be used not only in water purification technology, but also to remove water and condensate from industrial and natural gases; to recover valuable substances from the air of industrial enterprises; as a supplemental agent for removing harmful substances; and for other purposes in the chemical, petrochemical, construction, and other industries [9-15].

Therefore, the need to carry out basic research directed at developing scientific foundations to control the surface properties of carbonized dispersed minerals, for the purpose of creating effective coal-mineral adsorbents and other carbon silicate materials, is understood. But performing such a task is impossible without studying the problems associated with the kinetics and mechanism of carbonization processes, with the kinetics and mechanism of oxidation of the carbonized dispersed minerals formed, as well as the mechanism of the interrelationship of properties of carbon-silicate compositions with the conditions for obtaining them.

To explain the carbonization mechanism, the kinetic method was used together with adsorption, graphic derivation, X-ray diffraction, electron microscopic, and other physicochemical research methods. Analysis of the known models of heterophase reactions, to which the carbonization processes belongs, made it possible to establish that the most acceptable for the study of porous systems based on carbonized dispersed minerals was the model with the fixed range of reaction product [16, 17], which was used for the study of the

kinetics of the carbonization and subsequent oxidation of carbonized dispersed minerals when the processes are progressing under isothermal conditions. The iteration method was used to study the kinetics of carbonization of dispersed minerals [18]. Calculating the kinetic parameters at the extreme point of the differential-thermogravimetric curve of the derivation graph was used as the basis of this method [18]. Processing the data from the derivation graph by the iteration method (Table 1) made it possible to establish that the low-temperature dehydration processes of the various dispersed minerals, preceding their carbonization, are characterized by similar activation energies ( $28 \pm 5$  kJ/mol). The sizes of the activation energy values obtained correspond with the data of other authors [19] and, consequently, indicate the reliability of the method used. The surface diffusion of desorbed water molecules are the determining link in the low-temperature process. The structural properties of dispersed minerals do not exert a significant influence on this process. On the other hand, as Table 2 shows, the high-temperature dehydration or dehydroxylation processes under which carbonized silicates are also strictly formed depend to a significant degree on the crystal chemistry features of the dispersed minerals. Dehydroxylation of kaolinite, baddeleyite, and Pyzhevskiy montmorillonite controls the reactions of the thermal degradation of hydroxyl groups, whereas minerals of the Cherkasskiy deposit thermally degrade under conditions of significantly diffused restrictions, which is indicated by the sufficiently low activation energy of this process.

Table 1. Kinetic Parameters of Low-temperature Dehydration of Dispersed Minerals

(1) Минерал	(2) Параметры точки экстремума			(4) Кинетические параметры		
	$T_m, K$	$\alpha_m$	$\left(\frac{d\alpha}{dT}\right) \cdot m', \text{ min}^{-1}$	(5) $E, \text{ kJ/mol}$	$n$	$k$
(6) Черкасский палыгорскит	420	0.50	0.080	29	1.24	0.19
(7) Черкасская генетическая смесь палыгорскита и монтмориллонита	400	0.48	0.087	27	1.15	0.20
(8) Черкасский монтмориллонит	418	0.47	0.095	33	1.14	0.22
(9) Черкасская гидрослюда	395	0.46	0.087	30	1.05	0.21
(10) Пыжевский монтмориллонит	425	0.40	0.090	24	0.75	0.18
(11) Горбский бейделлит	393	0.47	0.095	28	1.10	0.22

Key:

- |  |  |
|--|--|
| 1. Mineral                                   | 7. Cherkasskiy genetic mixture of palygorskite and montmorillonite |
| 2. Parameters of extreme points              | 8. Cherkasskiy montmorillonite                                     |
| 3. $(d\alpha/dT) \cdot m', \text{ min}^{-1}$ | 9. Cherkasskiy hydrogenated mica                                   |
| 4. Kinetic parameters                        | 10. Pyzhevskiy montmorillonite                                     |
| 5. $E, \text{ kJ/mol}$                       | 11. Gorbkiy baddeleyite  |
| 6. Cherkasskiy palygorskite                  |  |

Table 2. Kinetic Parameters of Dehydroxylation of Dispersed Minerals

(1) Минерал	(2) Параметры точки экстремума			(4) Кинетические параметры		
	$T_m, K$	$\alpha_m$	$\left(\frac{d\alpha}{dT}\right), \text{ мин}^{-1}$	(5) $E, \text{ кДж/моль}$	$n$	$k$
(6) Глуховецкий каолинит	863	0,40	0,100	154	1,00	0,25
(7) Черкасский палыгорскит	825	0,34	0,045	33	0,44	0,07
(8) Черкасская генетическая смесь палыгорскита	760	0,44	0,048	47	0,90	0,10
(9) Черкасский монтмориллонит	815	0,29	0,054	44	0,42	0,09
(10) Черкасская гидрослюда	860	0,33	0,047	42	0,48	0,08
(11) Пыжевский монтмориллонит	973	0,33	0,080	124	0,65	0,16
(12) Горбский бейделлит	825	0,29	0,095	94	0,50	0,18

## Key:

- |                                     |  |
|-------------------------------------|--|
| 1. Mineral                          | 8. Cherkasskiy genetic mixture of palygorskite |
| 2. Parameters of extreme points     | 9. Cherkasskiy montmorillonite                 |
| 3. $(d\alpha/dT), \text{ min}^{-1}$ | 10. Cherkasskiy hydrogenated mica              |
| 4. Kinetic parameters               | 11. Pyzhevskiy montmorillonite                 |
| 5. $E, \text{ kJ/mol}$              | 12. Gorbkiy baddeleyite                        |
| 6. Glukhovetskiy kaolinite          |  |
| 7. Cherkasskiy palygorskite         |  |

Table 3 shows the activation energy of the carbonization process of various dispersed minerals by cellulose and saccharose. From the data presented it is obvious that the carbonization process is mainly determined by the thermal degradation of the organic substance and its nature, while the structural features of dispersed minerals are of secondary importance. This conclusion can also be drawn from an analysis of the curves of the differential thermal analysis obtained for pure minerals and mixtures with lignin, cellulose, and saccharose. Thus, the presence of a wide-range exothermic effect, the start of which for all mixtures is the same temperature (300°C), is characteristic for mixtures of dispersed minerals and the organic substances specified. Carbonized dispersed minerals begin to form above this temperature. On the other hand, the termination temperature of the exothermic effects, corresponding to oxidation of the previously formed carbonized silicates, depends to a significant degree on the structural features of the initial dispersed minerals. These results indicate that the carbonization process is accompanied by the formation not of a mechanical mixture of the dispersed mineral and carbon, but of the carbonized dispersed mineral, i.e., the mineral whose inner surface is covered by products of the thorough thermal degradation of organic substances. As the results of X-ray diffraction analysis have shown, the structure of the initial dispersed mineral is maintained, fulfilling the role of framework carrier of the carbon layer. Electron microscopic studies made it possible to establish that particles of dispersed mineral are evenly covered by a thin layer of carbon, forming during the thermal degradation of the organic substance. According to data from the derivative graphic analysis and EPR [electron paramagnetic resonance] spectroscopy, the most intensive carbonization process proceeds in the temperature range of from 450°C to 550°C.

Table 3. Kinetic Parameters of Carbonization of Dispersed Minerals With Cellulose (C) and Saccharose (S)

(1) Вещество или смесь	(2) Параметры точки экстремума			(4) n	(5) Кинетические параметры	
	T, K	$\alpha_m$	$(\frac{d\alpha}{dt})_{m, \text{ min}}$		E, $\frac{\text{kJ}}{\text{mole}}$	k
(6) Целлюлоза	753	0.33	0.36	0.76	380	0.83
(7) Каолинит + Ц	618	0.47	0.37	1.60	395	1.20
(8) Пальгорскит + Ц	613	0.46	0.37	1.50	365	1.20
(9) Генетическая смесь + Ц	623	0.46	0.37	1.50	360	1.10
(10) Черкасский монтмориллонит + Ц	633	0.36	0.44	1.50	365	1.10
(11) Гидрослюда + Ц	623	0.46	0.37	1.10	360	1.10
(12) Пыжевский монтмориллонит + Ц	613	0.47	0.37	1.60	390	1.25
(13) Бейделлит + Ц	623	0.47	0.37	1.60	405	1.25
(14) Асканский монтмориллонит + Ц	623	0.47	0.38	1.60	410	1.30
(15) Сахароза	573	0.50	0.07	1.37	54	0.18
(16) Каолинит + С	563	0.43	0.09	0.94	50	0.19
(17) Пальгорскит + С	523	0.36	0.11	0.73	50	0.21
(18) Генетическая смесь + С	513	0.38	0.12	0.78	54	0.25
(19) Черкасский монтмориллонит + С	563	0.50	0.08	1.25	50	0.18
(20) Гидрослюда + С	533	0.46	0.09	1.07	46	0.19
(21) Пыжевский монтмориллонит + С	563	0.45	0.08	0.97	42	0.16
(22) Бейделлит + С	543	0.38	0.09	0.72	42	0.19
(23) Асканский монтмориллонит + С	553	0.45	0.08	0.97	46	0.17

Key:

- |  |                                     |
|--|-------------------------------------|
| 1. Substance or mixture                | 13. Baddeleyite + C                 |
| 2. Parameters of extreme points        | 14. Askanskiy montmorillonite + C   |
| 3. $(d\alpha/dt) \cdot m, \text{ min}$ | 15. Saccharose                      |
| 4. Kinetic parameters                  | 16. Kaolite + S                     |
| 5. E, kJ/Mol                           | 17. Palygorskite + S                |
| 6. Cellulose                           | 18. Genetic mixture + S             |
| 7. Kaolite + C                         | 19. Cherkasskiy montmorillonite + S |
| 8. Palygorskite + C                    | 20. Hydrogenated mica + S           |
| 9. Genetic mixture + C                 | 21. Pyzhevskiy montmorillonite + S  |
| 10. Cherkasskiy montmorillonite + C    | 22. Baddeleyite + S                 |
| 11. Hydrogenated mica + C              | 23. Askanskiy montmorillonite + S   |
| 12. Pyzhevskiy montmorillonite + C     |                                     |

With the goal of obtaining additional information about the carbonization mechanism, the kinetics of interaction of the mineral palygorskite with cellulose and saccharose under isothermic conditions was studied [20]. As calculations have shown, the decomposition of saccharose, both in pure form and in a mixture with palygorskite, is controlled by the thermal degradation reaction of the organic substance, since it conforms to the kinetic equation

$$[-\ln(1-\alpha)] = K \cdot t$$

where  $\alpha$  is the degree of interaction and  $t$  is time. Saccharose decomposes with preliminary melting, which leads to its filling the porous space of the dispersed mineral, in which the subsequent decomposition process occurs. Unlike saccharose, the thermal degradation of cellulose is controlled by the

reaction of formation of a nucleus of a new carbon phase, since it is governed by Yerofeyev's equation. Cellulose, like lignin, decomposes to solid phase. Therefore, the carbonization process can proceed only at the expense of gasforming products of its thermal degradation, which diffuse to the active catalytic centers of the surface of the dispersed mineral, where the polycondensation reaction occurs.

The data obtained showed that the properties of carbonized dispersed minerals must be dependent on both the nature of the organic modifier substance, as well as the structural peculiarities of the dispersed minerals. Therefore, the problem of the interrelationship of the surface properties of dispersed minerals, their carbonization conditions, and the adsorption-structural properties of the carbonized dispersed minerals being formed take on special significance (Table 4). From the data shown in Table 4, it is obvious that the specific surface of the KDM, in fact, is determined both by the nature of the organic substance, as well as the structural features of the dispersed mineral. Here, the following law is observed: the greater the specific surface and porosity of the dispersed mineral and solid products of thermal degradation of organic substances, the greater the importance of these characteristics for the carbonized dispersed mineral. Yet, carbonization leads to a reduction of the adsorption-structural characteristics of the KDM in comparison with the initial minerals (Table 5), although according to absolute values the specific surface and porosity of some samples, they are not inferior to KAD-grade active carbon. Attention is drawn to the fact that the reduction of the total amount of macro- and mesopores after carbonization correlates to the reduction in the amount preliminarily adsorbed, determined by adsorption of benzene vapors. Carbonization proceeds mainly in macro- and mesopores of the mineral, also blocking the inlets of a portion of the ultra-micropores, since benzene can not penetrate the microporous structure of the dispersed minerals.

Table 4. Specific Surface of Products of the Interaction of Dispersed Minerals with Cellulose and Saccharose (500°C, 1/hr)

(1) Термически обработанное вещество	(2) Удельная поверхность (по аргону), м <sup>2</sup> /г		
	(3) минерала	(4) продуктов взаимодействия	
		(5) с целлюлозой	(6) с сахарозой
(7) Карбонизированная целлюлоза	—	21	—
(8) Карбонизированная сахароза	—	—	3
(9) Неркасская палыгорскит	123	59	48
(10) Неркасская генетическая смесь	225	163	104
(11) Неркасская гидрослюда	146	88	88
(12) Неркасская монтмориллонит	70	8	1
(13) Выжевский монтмориллонит	28	14	10
(14) Асканский монтмориллонит	35	11	7
(15) Горбский бейделлит	63	36	29
(16) Луковецкий каолинит	11	14	39

[Key on next page]

Key:

- |   |                                   |
|---|-----------------------------------|
| 1. Thermally treated substance          | 9. Cherkasskiy palygorskite       |
| 2. Specific surface (by argon), $m^2/g$ | 10. Cherkasskiy genetic mixture   |
| 3. Mineral                              | 11. Cherkasskiy hydrogenated mica |
| 4. Interaction products                 | 12. Cherkasskiy montmorillonite   |
| 5. With cellulose                       | 13. Pyzhevskiy montmorillonite    |
| 6. With saccharose                      | 14. Askanskiy montmorillonite     |
| 7. Carbonized cellulose                 | 15. Gorbskiy baddeleyite          |
| 8. Carbonized saccharose                | 16. Glukhovetskiy kaolinite       |

Table 5. Structural Sorption Characteristics of Treated (T) and Carbonized Cellulose (K) with 500°C Minerals

(1) Минерал	(2) $a_m$ $\frac{Mmol}{g}$	(3) $S_{уд}$ $\frac{m^2}{g} H_2O$	(4) $V, cm^3/g$		(5) $V_{пор}, cm^3/g$		(6) $V_{ма}$		(7) $V_{mi}$	(8) $V_{per}$	(9) $V_{ma}$	(10) Количество углерода, %
			$H_2O$	$C, H_4$								
(10) МОНТОРИЛЛОНИТ												
T	2.23	145	0.30	0.10	0.20	0.09	0.01					(14) Нет
K	0.76	50	0.12	0.05	0.07	0.04	0.01					8.0
(11) ПАЛЫГОРСКИТ												
T	2.04	133	0.42	0.21	0.21	0.17	0.04					Нет
K	1.32	86	0.31	0.17	0.14	0.08	0.09					9.8
(12) ГЕНЕТИЧЕСКАЯ СМЕСЬ												
T	2.31	150	0.45	0.27	0.18	0.19	0.08					Нет
K	1.37	89	0.35	0.23	0.12	0.16	0.07					11.0
(13) ГИДРОСЛЮДА												
T	1.43	94	0.43	0.28	0.15	0.15	0.13					Нет
K	0.78	51	0.35	0.23	0.12	0.10	0.13					8.2

Key:

- |                             |                       |
|-----------------------------|-----------------------|
| 1. Mineral                  | 8. $V_{per}$          |
| 2. $a_m$ , $Mmol/g$         | 9. $V_{ma}$           |
| 3. $S_{spe}$ , $m^2/g H_2O$ | 10. Montmorillonite   |
| 4. $V$ , $cm^3/g$           | 11. Palygorskite      |
| 5. $V_{por}$ , $cm^3/g$     | 12. Genetic mixture   |
| 6. Amount of carbon, %      | 13. Hydrogenated mica |
| 7. $V_{mi}$                 | 14. No                |

All of the results shown above indicate that by varying the carbonization conditions it is possible to change the properties of the carbonized dispersed minerals over a broad range. The wide-ranging possibilities for directed change in KDM properties open up different methods for modification, in particular, methods for their oxidizing activation. Kinetic studies actually confirm this. Thus, the results of research into the kinetics of oxidation of carbonized minerals of the Cherkasskiy deposit under isothermal conditions showed that below 450°C the process is limited by the rate of diffusion of oxygen to the depth of the nucleus and the structural features of the KDM, and above this temperature it switches to the kinetic region, not

depending on the structural features of the KDM, and is determined by the rate of degradation of the carbonyl and carboxyl groups of the carbon surface [21].

In the temperature range between 600°C and 700°C, oxidation once again switches from the kinetic to the diffusion region. This is associated with the intensifying sintering processes of the transport vapors, hindering the mass transfer of oxygen to carbon phase dislocation points. This mechanism of the process was confirmed by the independent adsorption method. The results of the theoretical and experimental analyses of the basic laws of formation of carbonized structures shown demonstrate the way to obtain carbon dispersed materials with assigned properties. In this way, it is possible to obtain not only carbon-mineral adsorbents with assigned properties, but also fillers of various polymer agents, catalyst carriers, ceramic materials with special characteristics, etc.

The role of heat-treated and carbon-containing materials in the technology and chemistry of silicates in obtaining ceramic articles for various purposes is especially great. Since silicates (clay minerals) contaminated by various organic substances are used in the manufacture of ceramic articles, they test the most diverse conversions during sintering. As was established, the carbonization process of natural silicates begins at temperatures above 300°C, and proceeds most actively in the range of from 450°C to 600°C. When sintering articles in an oxidizing atmosphere above 400°C to 450°C, their breakdown by burning away carbon under the effect of the oxygen in the air occurs in parallel with the formation of carbon-containing silicates. It would seem--with an increase in temperature this process must according to the law intensify--that it would lead to the creation of such a sintering technology, in which it was recommended to perform a temperature shut-down (delaying heating by three to five minutes) at 850°C to 950°C. Such a shut-down is necessary for complete burn-off of the organic substances to prevent the formation of a "black core" (when the cake is crushed its inner, core portion has a black or dark color). The presence of such a core is intolerable and leads to rejection of the article.

Our studies, which were of a mainly fundamental nature, showed that the process of oxidizing carbon-containing silicates most actively proceeds between 450°C to 600°C, since, with an increase in temperature, caking of the openings of small pores and cracks begins, on whose surface carbon is deposited, formed through the thermal breakdown of organic substances. Under such conditions (at temperatures above 600°C), the admission of oxygen into pores containing carbon is hindered as a consequence of the caking of their openings, and the process of carbon burn-off not only does not accelerate, but oppositely, even slows, and can proceed at an insufficient level. The basic results of research presented here, directed at exposing the mechanism of the formation and oxidizing decomposition of carbon-containing silicates, and at the development of theoretical bases of controlling their properties, also seemed useful in creating an efficient technology for sintering ceramic articles: industrial experimental tests and industrial verifications showed that the three to five minute temperature stoppage when sintering ceramic articles containing natural silicates is best done at 500°C to 600°C. Under



such conditions, the carbon contained in the silicates burns away more completely than at 850°C to 950°C. The data presented once again show by what method goal-oriented fundamental and applied research are directly connected.

While studying the physicochemical properties of heat-treated and carbon-containing silicates, another problem was solved, of great importance for the chemical engineering in obtaining ceramics. Its essence is that with wet preparation of the ceramic raw material, the moisture of the slip, as a rule, is from 45% to 50%. A significant amount of water is consumed in the preparation and subsequent drying of such slips, and then an even more significant amount of natural gas is used to evaporate it. This problem has arisen especially sharply in recent years in connection with the shift to low-quality clay raw materials and carbon-containing silicate metallurgical slag and ash from thermal power plants. The basic reason for this appears, in our view, to be the inadequate prior study of the physicochemical and colloid-chemical processes ongoing during the processing of carbon-containing secondary products of manufacturing in an aqueous medium.

The research of the physicochemical properties of heat-treated and carbon-containing silicates that has been conducted made it possible to develop the basic principles of controlling characteristics and, on that basis, to create the energy- and resource-saving technology of the wet preparation of the ceramic raw material using special chemically active alkaline thinning agents. The technology that was developed solves a number of problems in the chemical technology of silicates and in the ceramic industry, associated with: protecting the environment (efficient use of heat-treated and carbon-mineral wastes, as well as the waste of ceramic production itself); protecting the water table and saving water (water consumption has been reduced by 20% to 30%); and saving fuel and energy (provides a 15% to 20% decrease in the consumption of natural gas for drying the slips and electricity by decreasing the moisture content of the slip by 6% to 8%). In addition, using the technology developed increases equipment productivity by 15% to 20%, and labor productivity in preparing the raw material by 10% to 15%. In many cases, the quality of the articles obtained increases to a significant degree.

At the present time, the introduction of the results of the scientific research made it possible to obtain a tangible economic effect, exceeding 500,000 rubles, in many enterprises of the country. In perspective, as computations show, if only the ceramic industry fully converted to the new technology the economic effect from its use could be up to three million rubles, mainly through fuel and energy savings. However, the completion of such work requires further research of the raw material base of the silicate industry, whose foundation is made up of natural, heat-treated, and carbon-containing dispersed minerals.

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12304

CSO: 1841/134

## GORBACHEV CALLS FOR USE OF IMPORTED HEAVY EQUIPMENT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 1 Dec p 1

[Article by N. Lemayev, minister of the USSR Petroleum Refining and Petrochemical Industry under the "Effectiveness of a Newspaper Speech" rubric: "Are Those the Conclusions Made?"]

[Text] After the speech of General Secretary of the CPSU Central Committee M. S. Gorbachev at the meeting on the problems of the acceleration of scientific and technical progress and the critical article, "Are Those the Conclusions Made?" published in the newspaper SOTSIALISTICHESKAYA INDUSTRIYA on August 1, the USSR Ministry of the Petroleum Refining and Petrochemical Industry developed and accomplished measures for acceleration of the bringing of uninstalled equipment into use.

Together with contract organizations of the construction ministries, schedules were developed for each building for bringing into use of starting sites, which are built on imported equipment, and control is established for their fulfillment.

As the result of the measures taken, fulfillment of the plan of the construction and installation work on starting sites is assured, the building of which is accomplished on units of imported equipment.

With careful working of the project plan for 1986, the ministry, together with the USSR Gosplan and the construction ministries, decided on an increase of 20 percent over the level of the current year of the volumes of contract work to be fulfilled by the USSR Ministry of the Construction Materials Industry, the USSR Ministry of Heavy and Transport Machine Building, and the USSR Ministry of Construction. This enabled the concentration of construction and installation work at sites with imported equipment to be increased to 50 percent of the total maximum versus 31 percent in the current year and provides the bringing of fifteen capacities into use on imported equipment.

At the present time, the development of the project plan of the 12th Five-Year Plan has been completed. In conformity with the control figures of the Basic Directions of the development of the branch for the years 1986-1990 and up to the year 2000 and the Over-All Program of the Chemization of the National Economy, the ministry provides top priority allocation of capital outlays for development of capacities for deep treatment of petroleum, the production of lubricating oils, liquid paraffins, tires and industrial rubber products, synthetic rubber and monomers; the use of present equipment primarily is held in view.

To fulfill these tasks, the ministry allocated a capital outlay of 11.3 billion rubles. Moreover, the growth of an active part of the basic funds is envisaged because of putting into operation of equipment from 50.2 percent of the total volume of the capital outlays in the 11th Five-Year Plan to 58 percent in the 12th.

It is planned to bring into the 12th Five-Year Plan all sites for which imported equipment is left over, moreover, 90 percent of them in 1986-1988. All uninstalled imported equipment will be in operation with the bringing in of these sites.

Simultaneously, the ministry took measures for careful studying of the problems of the expediency of further purchase of equipment for the 12th Five-Year Plan. Delivery of imported equipment is planned chiefly because of receipts from Comecon countries according to long-term agreements for assuring development of the branch in accordance with the Over-All Program of Chemization of the National Economy.

The speech in the newspaper enabled the attention of the USSR Gosplan and the construction ministries to be attracted to the problem of the use of imported equipment and proved to be a positive influence on the achievement of improved measures for acceleration of its being brought into operation.

On its side, the colleagues of the ministry on 14 November 1985 in the order of verification of decisions made earlier discussed the course of removal of deficiencies in the use of uninstalled equipment and noted additional measures, having in view the provision of unconditional fulfillment of the tasks for bringing the imported equipment into operation and reducing its storage remains.

12410

CSO: 1841/196

ESTONIAN PLANT RECOVERS SULFUR PRODUCTS FROM AIR

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 Nov 85 p 1

[Article by correspondent V. Proskura, ESSR: "Raw Material from Air"]

[Text] The Estonfosforit Association has learned how to obtain additional raw material from the air in the literal meaning of the word. Local chemists in collaboration with Moscow specialists introduced a new technology for the utilization of wastes from the manufacture of sulfuric acid gases and other source products.

Without a shutdown of production, the phosphorite workers reconstructed the technological cycle of the enterprise. As the result, the expenditure for raw material to obtain acids was reduced by many thousands of rubles, and the air reservoir above the production zone became pure.

12410

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UDC 621.592

EXPERIMENTAL TESTING OF GAS CRYOGENIC ENGINE WITH STAGED REGULATION OF COOLING CAPACITY

Moscow KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian No 10, Oct 85, pp 12-14

SMIRNOV, A.V., MYASNIKOV, V.M., Engineers, BAKHNEV, V.G. and PRUSMAN, Yu.O., candidates of technical sciences

[Abstract] Stirling gas cryogenic engines normally have an excess cooling capacity to allow for start-up requirements, resulting in uneconomic operation under steady-state conditions. To correct this, an experimental engine was developed which allowed a staged regulation of the cooling capacity by varying the pressure in the operating cycle and the rotation rate of the crankshaft. This experimental engine had a two-speed electric motor with a reducing gear. The compression chamber was connected through a check valve and a solenoid valve with the housing. This engine could operate at four levels with identical housing pressures of 1.8 MPa by varying the crankshaft speed from 1500 to 2250 r/min and by opening or closing the solenoid. Opening the solenoid decreased the time to reach operating conditions by 20-25% and increased power consumption by 19-20%. Increasing the crankshaft speed gave a 50% increase in cooling capacity and decreased time to reach operating conditions by 40-45%, while increasing power consumption by 60-65%. Both opening the solenoid and increasing the crankshaft speed increased both the cooling capacity and the power consumption by 80-85%. Using this operating level allowed a 40% reduction in start-up time. At lower heat-flow levels, lowering housing pressures and crankshaft speeds can further reduce wear on the engine and extend operating life. Figures 3; references 3 (Russian). [208-12672]

## CORROSION RESISTANCE OF MATERIALS IN PRODUCTION OF SYNTHETIC ACIDS

Moscow KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian No 10, Oct 85  
pp 19-20

KOSMENKO, Yu.L., candidate of chemical sciences, and BAYDIN, I.I., engineer

[Abstract] The corrosion resistance of a number of steel and titanium materials used in the production of synthetic fatty acids was tested by the Volgograd branch of VNIIPAV [All-Union Scientific Research Institute of Surface Active Substances?]. Industrial fractions of acids  $C_5$  to  $C_{25}$  were boiled in a titanium apparatus with a cylindrical test chamber equipped with three hangers for holding 20 x 50 mm metal samples. System vacuum was formed with a water-stream ejector and controlled by a vacuumometer. The middle hanger had an internal heater; samples on it were subjected to a heat flow of 21,000 kJ/(m<sup>2</sup>h), a typical heat flow for commercial diphenyl heat exchangers. Samples on the lower hanger were completely immersed in the liquid acids, while those on the upper hanger were suspended in the vapor phase. Test runs lasted 120 h at temperatures of 180-300° C and pressures of 0.3-0.4 kPa. Speed of corrosion was evaluated by weight loss and by the appearance of surface defects. The acids showed high corrosion activity against chrome-nickel steels. For steels 12Kh18N10T, 10Kh17N13M2T and 08Kh17N15M3T, experimental corrosion rates were 0.12-0.67 mm/yr in the vapor phase, while 06KhN28MDT and KhN65MV gave values of only 0.021-0.082 mm/yr. Corrosion rates increased in the liquid phase, often with pitting. Highest corrosion rates were from samples with the fatty acids boiling off the heated metal surfaces, more than doubling rates in the liquid phase without heat flow through the samples. Nickel and chrome-nickel steels, even those with over 3% molybdenum, showed a high rate of attack; steels 12Kh18N10T and 10Kh17N13M2T showed irregular corrosion with the metal structure etched and pitted. Titanium VT1-0 showed high corrosion resistance, with a corrosion rate of only 0.006-0.036 mm/yr in the vapor phase. Figures 1; references 3 (Russian).  
[208-12672]



## COAL GASIFICATION

### SURVEY OF KANSKO-ACHINSKIY FUEL ENERGY COMPLEX

Moscow ZNANIYE-SILA in Russian No 10, 1985 inside front cover p 2

[Article by V. Krutikov, Candidate of Geographic Sciences: "KATEK: Ecology, Production, Technology"; (first paragraph (below) is in boldface and precedes the main body of the text; second paragraph is an introduction written in italics)]

[Text] The Kansk-Achinsk coalfields will play a critical role in meeting the country's energy requirements. Their resources will be utilized by the Kansk-Achinsk fuel energy complex (KATEK), which is the largest fuel energy complex being built in the world. KATEK is made up of strip mines, each capable of producing up to 60 million tons of coal per year, thermal electric power stations that can produce 6.4 million kilowatts apiece, and plants for processing coal and converting it into liquid and gaseous fuels. In the future, the coal from this basin will be the foundation of the supply and demand for energy in Central Siberia and will ensure the development of energy-intensive industries in this region. --Excerpt from the Basic Long-Term Energy Program of the USSR

The word "KATEK" has long been familiar not only to Siberians, but to others as well. The country's largest brown coalfield, the Kansk-Achinsk, is famous from the study of geography in school. Its resources served as the nucleus when the formation of the complex was begun. Now, when the top priorities of KATEK are receiving special attention in the decisions of the CPSU's 26th Congress and the USSR's Energy Program, the future of the complex and the solutions to the central problems of its development are exciting a great deal of interest.

KATEK is not a project for one or two five-year plans. The complex is planned to reach projected capacity after the year 2000. This "unprecedented constellation of energy giants", conceived on drawing boards and in the press in the sixties, requires more careful economic forecasting and environmental planning. Shifts that have since occurred in the development and configuration of the economy, and changes in the country's energy requirements have prompted changes in how the future complex is conceptualized. The environmental consequences of the implementation of earlier designs have been the focal point of research. This article covers this issue and the changes in the strategy for developing KATEK. --Academician T. Khachaturov

What is KATEK?

The territory of KATEK, in contrast to the majority of the other regions of Siberia, has been well developed for a comparatively long time. The population is frequently as dense here as in the country's other central regions. This is Siberia, but it is southern Siberia, and it lies in the same latitudes as the Moscow metropolitan area. Nearly two million people live here, and there are both large and small cities and towns. The region has a mature industrial base complemented by one of the most important agricultural regions of Siberia.

The way of life, the natural surroundings, and the resources of this region are unique. Stretching from east to west for almost 800 kilometers from Mariinsk in the Kemerovo Oblast to Kansk in the Krasnoyarsk Kray, KATEK's territory, which varies in breadth from 250 to 300 kilometers, takes in forested steppes, deciduous and dark coniferous taiga, plateaued plains, mountains and their basins, the valleys of the Yenisey and its tributaries, swamps and arid lands, and large and small fresh- and saltwater lakes. All of these contrasts in the natural surroundings should not hide the fact that this territory is exceptionally well suited (by Siberian standards) to human habitation, agriculture and animal husbandry, and the development of many types of industry.

The key to developing the territory of KATEK was found, perhaps, as early as the thirties. At that time, the conceptualization of the Great Angaro-Yenistroy Project cast the energy-yielding coals of the Kansk-Achinskiy fields in the role of a unique starting mechanism that would use a "current of heat" to "stoke" the economic life of the kray. Now these coal resources have become the foundation for one of Siberia's greatest territorial production complexes.

A territory with such favorable natural resources and economic conditions means just as much to the country and to Siberia as the oil-and-gas producing regions. It is very important to manage this wealth wisely, and to chart the right strategy for its development...

#### The Concept of Coal

The concentration of huge resources within a comparatively small territory which holds vast potential for wealth and other obvious assets nevertheless conceals a certain danger. Sometimes, project engineers lose their sense of time, make poor forecasts, and, while extolling the virtues of their projects, make the scale of their projects bigger and bigger. In the meantime, they forget about the unavoidable difficulties of realizing their ideas. Later, all of this is justified by "objective factors" and the very best of intentions. However, the miscalculations that are figured into the actual "territorial development" do not lose their impact as a result.

What will KATEK be? This is not just a function of progress in the coal industry and in electrical power engineering. The realm of this complex is immeasurably larger. It has figured in the lives of many generations of the local populace and new residents. What happens to KATEK will affect the

future of not only Siberia, but the country's economy as a whole. It is unthinkable that this future can be properly understood from a strictly bureaucratic or local point of view.

Today, the "scenarios" for KATEK are not being written by just the executives of the branches involved. Within the framework of the familiar "Siberia" scientific program, a special research division known as "The Kansk-Achinsk Coalfields" has been dedicated to this problem. In the minds of Siberian scholars, the crux of the matter lies in formulating a specific and methodical point of view. This point of view, along with institutional outlines for the development of the individual components of the future complex, evaluates the role of the complex in the production of energy and in the economy of Siberia and the USSR. Moreover, this evaluation proceeds from the assumption that KATEK, which in and of itself is a complex entity, will be the nucleus of even more complex systems.

The general concept for the development of KATEK has changed greatly over time as preliminary projects have been drafted. At first, it was proposed to build 18 of the largest GRES' (State Regional Power Plants), more than 10 high-output coal mines, and about 20 waterworks in just the western part of the complex. Concentration and production growth rates of this magnitude within KATEK were justified by the increasing demand for energy in the European part of the USSR and in the Urals. Later, however, when the enormous energy-producing plants were in the design stage, new circumstances arose, and specific constraints on the technology, economics, and environmental aspects of the project were discovered.

What are the causes of the changes that have taken place? First, the western regions of the country now have better energy supplies. Today, the ability of Kuzbass to supply coke and energy coals to users in the Urals and in the European part of the country is regarded differently. Moreover, Kuzbass is several hundred kilometers closer to these regions than KATEK, and it is less costly to reconstruct Central Siberian highways for the purposes of transporting Kuznetsk coal than to build super long-range electric power lines. Second, Kansk-Achinsk coal is now a bigger factor in the supply and demand for energy in Siberia, where energy-intensive industries are growing at faster and faster rates and where the construction of hydroelectric power plants noticeably and without complete justification has outstripped the construction of the systems of basic GRES' and TETs' (thermal-electric power plants).

Now, science and practical experience are redefining the constitution and growth rates of KATEK's main industrial plant, along with its geographic effects. Also, the problems entailed in preserving the natural surroundings have become more complex, and special attention is now being given to the environmental and social consequences of implementing these decisions.

### Ecology

Various studies have determined that energy production is responsible for more than half of all the harmful effects suffered by the environment as a result of the world's economic activities. The construction of large

energy projects similar to KATEK affect the environment in such a way that fundamental changes with sometimes undesirable demographic and social consequences take place. That is why the "Kansko-Achinskiy Coalfields" program includes, along with its studies on coal-recovery and utilization technology and production economics, a special sub-program entitled "A Study of KATEK's Natural Surroundings as a Backdrop for Economic Development and the Constraints They Present (the Ecology of KATEK)". This subject is being studied by nearly thirty research and planning institutions, as well as by the country's institutions of higher learning. One of the primary executive bodies and the chief coordinating body of the environmental impact studies is the Institute of Siberian and Siberian Far East Geography of the USSR Academy of Sciences. In the opinion of geographic scholars, this kind of sober attitude towards the problems of wisely managing KATEK's natural surroundings is not an accident. The concentration of numerous coal mines, GRES', and other plants in a comparatively small area, primarily in the western part of the complex (about 20 thousand square kilometers) will unavoidably put a tremendous strain on the environment and significantly affect the local economy and way of life. The unprecedented scale of the projected enterprises, the new technologies, and the greatest concentration of energy-producing capacity in the world all bear a direct relationship to the environmental impact of the complex. The solution to this problem will require an integrated approach, wherein not only branch and local considerations, for example, compliance with permissible emission levels by individual enterprises, will be important, but also consideration of the comprehensive, synergistic impact on the environment of all the plant complex. The geographic sciences, which study both natural and economic systems, are well equipped to work with this problem.

Scientific research done in the interests of optimizing the custodianship of KATEK's natural surroundings is moving in several directions at once. First of all, it is necessary to have a clear understanding of the natural, economic and social conditions of the KATEK territory as they stand today. Since, as has already been pointed out, this is one of Siberia's most developed regions, it is especially important to take into account the effect this has had on the natural surroundings and the economy. The next step is to study the sources and processes that contribute to the impact that the complex as a whole and its individual components have on the environment and the economy. Here, experimental research takes the lead as it studies natural cycles (the background) and the impact of new technogenic processes. Active laboratory and field experiments to determine how much the natural surroundings can tolerate have been started.

Ecological forecasting is especially important at KATEK. One of the first forecasts concerning KATEK prepared by institutions of the USSR Goskomgidromet (State Committee on Hydrometeorology) and several other organizations has already affected the construction of the complex a great deal.

Ecological research has one other very important responsibility. A great many people come from all over the country to work on the complex. They must settle in, and in this regard, the ecological situation at the complex is far from being irrelevant. At the same time, it is just as dangerous to underestimate unfavorable consequences as it is to exaggerate them. It is necessary to

raise the ecological awareness of the KATEK residents. The preservation of the natural surroundings depends not only on the decisions laid down in the plans, but also on how they are implemented during work on the complex. If people recognize that the quality of their life to a great extent depends on them, on their carrying out environmentally safe methods of operating equipment, and on their having a custodial attitude towards nature when they take their recreation outdoors, then the problems that are important for all of society will be solved more quickly.

#### Local Conditions

The distinguishing characteristics of the natural surroundings and resources will, of course, be evident in the future ecology. Therefore, the ecological forecast must account for all of the substantive conditions of the location of the new complex. The main resource of KATEK's territory is coal. From an ecological standpoint, it has advantages over the solid fuels of several of the country's other fields. During combustion, the amount of basic harmful admixtures given off by Kansk-Achinsky coals is several times smaller than that of Kuznetsk, Donetsk, Moscow, and Ekibastysk coals. KATEK coal has a low sulphur content, a lot of water, and its ash has a high content of calcium oxide, which is difficult to neutralize. Moreover, different coalfields have different kinds of coal. Thus, the worst kind of coal, from the standpoint of air pollution, is itatskiy coal. It has to go through preliminary processing. Also, a coal's properties do not always have the same effect. The very same calcium oxide that finds its way into the environment as part of the waste emissions of a GRES can to a certain degree act as calcifying neutralizer for acid podzolic soils. Geochemical research done near the Nazarovsk GRES, which is fueled by local coals, has shown that the soils in this area are beginning to change.

The composition of the rock which forms the overburden of the coal beds has hardly been studied. Meanwhile, this rock contains a number of minerals of industrial significance. They include building materials as well as raw material for producing aluminum. Available data indicate that these ore deposits are integrated, and this will require a new and non-conventional approach towards developing KATEK's mineral resources.

Coal mining and the problems of KATEK's agricultural resources are intimately related. From a narrowly economic point of view, "close" coal costs less. However, huge open-pit mines destroy huge areas of valuable farming land.

In the southern part of the Krasnoyarsk Kray, the best lands are already developed. Moreover, erosion has begun even when standard agricultural methods are used.

As KATEK's industrial might is developed, the protective role of the forest becomes bigger. As greater demands are made, more forest is required. There are few forested areas in the originally developed territories. Many of the forests' regulating functions, for example hydrological and climatic, occur in extremely important territories. Therefore, the plant life of the forests is extremely important in the preservation of the climate and clean air, not

just in the regions where KATEK's main components are located, but also in adjacent territories and even in territories that are farther away.

The situation with water resources is becoming fairly complicated. As a whole, Siberia is considered one of the most bountiful regions of the country in terms of water. However, the distribution of water supplies is uneven here, too. In the western section of KATEK, where construction of the first components has begun, water supplies are tight. Here, river discharge greatly depends on the time of year. According to experts, the "dilution" capability of a number of rivers is already starting to decline, and therefore it is necessary to take steps to solve water-supply problems.

### Technology and Ecology

The condition of the environment will depend to a great extent on decisions made about technology during the mining and processing of coal and the production of electrical and thermal energy.

Arable lands can be preserved with the help of "modular" development technology. Its most distinctive feature is the dumping of the overburden directly into the strip being worked, and if this is not feasible, dumping it on land that is not fit for cultivation. In addition, the topsoil can be removed from the fields where future strip mines will be located.

To keep from fouling the air around the coalfields, the plans call for watering down the mass of the mine, the roads, and the working areas and using dust-trapping equipment. Explosives operations will account for the dispersion of admixtures that adversely affect meteorological conditions. Enclosed conveyors will be built to transport coal from mines to electric power stations.

The development of powerful and highly efficient turbogenerators for thermal electric power stations is an important achievement of power engineering in the Soviet Union. This type of machinery will be installed in the first of KATEK's GRES'. As a specific example, the primary power unit for the Berezovsk GRES-1 has a rated capacity of 800 megawatts. Its boiler plant weighs nearly 20 thousand tons. The furnace chamber for this type of boiler has a base area of 23 square meters and a height of nearly 100 meters. In one hour it can burn 450 tons of coal, and a station that has eight of these power units can burn 3600 tons, i.e., an average trainload.

However, running one of these electric power stations presents a number of technological and ecological problems. Among them is the question of what to do with the waste from the GRES, which can amount to 1.5 to 2 million tons per year. Much needs to be done to solve problems having to do with pollution from solid, gaseous, and thermal emissions by electric power stations. Water-management problems are in the forefront, inasmuch as the biggest water users at KATEK will be the GRES' themselves. Here, the trail will be blazed by the incorporation of waste-free technologies and by the changeover to the use of recycled water at all enterprises.

Yet, there are problems that require urgent solutions. Before long, the first power unit of the Berezovsk GRES-1 will start putting out current. The

first thousands of tons of coal and slag will also make their debut. For all of Siberia's expanses, it is fairly difficult to find dump sites for the ash and slag near KATEK. The Nazarovsk GRES, which is already on line, produces hundreds of thousands of tons of ash and slag every year, and each new GRES will produce more than a million tons of this type of waste each year. The loss of prime agricultural land to the storage of this mass is not the only concern. Its chemical composition is such that barely soluble compounds do not form in the dumps. That is why conventional storage facilities for ash will threaten water and air quality and the ecological balance of the environment indefinitely.

The plans for developing KATEK have, it would seem, come up with a rational solution: to put the dry ash in exhausted coal stripmines. But even this does not completely eliminate the potential danger of polluting underground water tables. Moreover, such a solution is fraught with problems: coal miners have promised to set aside pits for this purpose only after 15 years.

Today, our country and the world have a great deal of experience in converting wastes into profits. Ways to use the ash and slag from Kansk-Achinskii coal to produce building materials have been developed, as have techniques for using this waste material for surfacing roads and calcifying acid soils. Scholars at the Siberian Department of the USSR Academy of Sciences recommend this ash as material for manufacturing calcium carbide, which greatly reduces its cost of production in comparison with the use of conventional technology.

However, these possibilities are not seen as a reality in the plans for the first KATEK GRES'. No decisions have been made concerning the construction of enterprises for the processing and utilization of ash and slag. Furthermore, the bad experience of Ekibastuz is well known. Ash-processing enterprises associated with local GRES' have been anticipated for a long time, but there are none yet. Meanwhile, a great deal of money and effort was needed to protect the dumps from the wind, which would carry the poisonous dust for several kilometers.

However, the new technologies have real possibilities. One of the methods proposed involves the use of power engineering technology to pre-process raw fuels in order to remove as much waste as possible before they are burned in GRES furnaces, and to convert the wastes into useful products. The technology for this is still being developed and undergoing limited industrial testing. However, it is already anticipated that if coals are processed using the power engineering technology developed at the G.M. Krzhizhanovskii power engineering institute, the quantity of light ash, sulphuric and nitrogen oxides, and heavy metal oxides in the emissions from electric power stations will be reduced nearly twofold. The development of other production processes that will undoubtedly be one more step towards the development of truly wasteless and environmentally safe technologies is ongoing.

However, scientific foresight must project itself beyond today.

The fact of the matter is that the measures that will be taken to protect KATEK's natural surroundings and that incorporate geographic expertise will

be sufficient only for the first stages of the complex's construction. As it approaches projected capacity, and as the energy-intensive complex is developed, previously effective technologies for cleaning exhaust and waste water, the super-tall smokestacks of the GRES', and even the greatest possible concentration of industrial plant will be unable to solve increasingly complex ecological problems. In other words, within the framework of conventional wisdom and technologies for mining, coal burning, production, and energy consumption, KATEK will not be able to maintain its environment in an acceptable state.

It is no accident that from an ecological, as well as an economic, point of view, the conventional technique of directly burning coal to obtain electrical energy and heat is far from being regarded as the only, and definitely not the best, method for the future utilization of large quantities of solid fuel. Science is already proposing other, radically new ways of exploiting the wealth of the largest coalfields. It is precisely these new ways that are envisioned by the Energy Program of the USSR.

As long as gargantuan coal plants remain few in number, their effectiveness will not be questioned. However, when KATEK's boundaries encompass more than ten or so of these mines; when, according to preliminary calculations, the western part of the complex alone will deprive the agricultural sector of 55 thousand hectares of land by the year 2000; and when for each working section with an annual capacity of 50 million tons of coal it will be necessary to process and transport 150 to 200 million tons of rock per year, the advantages of open-pit coal mining will be far from unassailable. Then, it is likely, it will be necessary to remember a technique that has been known about for a long time, but which has yet to become widely used: the underground gasification of coal, which as long ago as 1913 Lenin called "one of the great victories of technology". The industrial realization of this technique occurred only in the Soviet Union, which already had a great deal of experience in the gasification of coal underground under a variety of bedding conditions. The results obtained show that, in terms of labor productivity, underground coal gasification is as efficient as the conventional open-mining method. (Up to a billion cubic meters of gas obtained through underground coal gasification is currently being produced by the stations of the special organization "Podzemgaz".) The large-scale application of this technique will make the extraction of the liquid products of gasification profitable and will noticeably improve the economics of the entire process.

The economic and ecological effectiveness of burning Kansk-Achinsk coals is actually growing as the capacity of the machinery and of the electric power stations grows. This growth, however, has obvious constraints. For ecological considerations alone, the capacity of the GRES' in this area cannot exceed 6.4 million kilowatts. The newest techniques for burning coal directly in a "fluidized bed", as it is known, even though they improve the coal utilization rate and reduce the emission of nitrogen and carbon compounds, do not provide solutions for other waste products that are just as toxic and dangerous.

Modern science has proposed several techniques for preparing low-grade coals. The low-temperature carbonization and the gasification of coal are processes



that are scientifically sound and are closest to being incorporated. According to scientists' plans, it is possible to produce high-caloric powered low-temperature coke, liquid resins, and gas in specialized equipment using elevated pressure and quick heating. At large power-engineering combines it is planned to produce electrical energy and heat by burning low-temperature coke and gas, and the resins will be used as raw material for coal chemistry.

Future combines, which will replace the conventional Berezhovsk-1-type coal GRES', will produce energy more efficiently with the same capacity, and their atmospheric emissions will be one and one-half to two times lower. Moreover, this type of combine will produce up to three million tons of resin from low-temperature carbonization in one year. This resin is a valuable raw material for obtaining aromatic chemical products or for manufacturing artificial liquid fuel.

Techniques for gasifying coal above ground will also, without a doubt, contribute to the ongoing reconciliation of KATEK power engineering with the environment. One of the decisions recorded at the XXVI session of the CPSU was "To develop an industrial-scale experimental steam-and-gas unit with a capacity of 250 thousand kilowatts and internal-cycle solid-fuel gasification." Before it is burned in the furnaces of an electric power station, gas obtained in this manner is cleaned of harmful admixtures in order to minimize atmospheric emissions of sulphur and nitrogen oxides, ash, and other pollutants. This is much more efficient than the conventional scrubbing of enormous quantities of smoke and does not require the construction of expensive electro-filters and super-tall smokestacks. By-products from gas and energy-producing chemical combines will be valuable semi-finished chemical products and ash residue from the gas generators. Their utilization is completely feasible and profitable. Thus, combining the various techniques for pre-processing solid fuels with the continued production of electrical power, heat, valuable chemical compounds, and artificial liquid fuel within the framework of inter-branch combines will make it possible to come ever closer to a truly waste-free exploitation of Kansk-Achinsk coal.

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CSO: 1841/108

## COAL MINING ASSOCIATION EXCEEDS PLAN BY TWO MONTHS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 5 Nov 85 p 1

[Article by correspondent A. Maltsev; Kapinsk: "Two Months Ahead"]

[Text] By outstripping the production schedule for two months, the collective of the Vakhrushevugol Association reported the completion of the program of the 11th Five-Year Plan for fuel extraction. Only because of an increase in the quality of the coal, miners obtained 5 million rubles of profit, providing the national economy with an effect twice exceeding this sum. A great economy was achieved here also because of careful use of material resources. All the output above the plan was provided because of economized electrical energy, motor fuel, metal, and other materials.

The teams of the honored miners V. Shurudiviy and A. Kondrashov show an example of highly productive and economical work, who are the first at the enterprise to complete the Five-Year task.

The workers of the association resolved at the end of the year to mine an additional million tons of fuel, and in honor of the 27th CPSU Congress for two months of next year to give 20,000 tons of coal above plan.

12410

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UDC: 552.57.662

PROPERTIES OF COAL FROM AGULAK DEPOSIT AND POSSIBILITY OF PRODUCING MELLITIC ACID FROM IT

Moscow KHIMIYA TVERDOGO TOPLIVA in Russian No 5, Sep-Oct 85 (manuscript received 28 Oct 83) pp 28-33

SARTOVA, K.A., SARYMSAKOV, Sh.S., KOROLEVA, R.P., ALYBAKOVA, N.K. and ROZANTSEV, E.G., Institute of Organic Chemistry, Kirgiz SSR Academy of Sciences

[Abstract] A study is reported of the chemical and technological properties of coal from one promising deposit in Kirgizia, the Agulak deposit of the Kavac coal basin. This coal is mined by open pit mining and used as a domestic and power plant fuel. Oxidative destruction of the coal was used to produce aromatic polycarboxylic acids. Oxidative destruction was performed by two-stage oxidation, first with nitric acid, then with sodium hypochlorite. EPR spectra of the products indicated that thermal destruction was a multi-stage process including destruction and condensation, formation of free radicals, and their recombination and dimerization to form more condensed systems. Coal of the Agulak deposit is a potential source of raw materials for the production of aromatic acids such as mellitic acid. Optimal conditions of the process of thermal, thermocatalytic and oxidative destruction of the coal are determined. Thermally modified coal can yield mellitic acid 20.0% in two-stage oxidation. Introduction of 2.0 wt. percent  $AlCl_3$  accelerates the process of condensation in heat treatment, decreasing the temperature by 50-100°C and increasing the yield of mellitic acid to 32.2 percent. Figures 4, references 7: 6 Russian, 1 Western.

[174-6508]

## HYDROGENIZATION OF BROWN COAL FROM KANSKO-ACHINSK BASIN IN PRESENCE OF SMALL QUANTITIES OF MOLYBDENUM CATALYST

Moscow KHIMIYA TVERDOGO TOPLIVA in Russian No 5, Sep-Oct 85 (manuscript received 9 Feb 84) pp 48-52

KRICHKO, A.A., SHPIRT, M.Ya., YULIN, M.K., ZEKEL, L.A., PCHELINA, D.P., KRASNOBAYEVA, N.V. and SOLOVOVA, V.V., Institute of Fossil Fuels

[Abstract] Coal was hydrogenated by the method of the authors' Institute with catalytic quantities of ammonium paramolybdate and iron sulfate applied to the coal from aqueous solutions. A method was developed for production and study of the properties of ammonium paramolybdate solutions. The properties of the emulsions were evaluated by determining the change in concentration of molybdenum in a layer of emulsion at 1 cm depth below the surface. At 40 °C, this concentration decreased by 4% in 30 minutes, 18% in 1.5 hours. The results indicate that the emulsion of ammonium paramolybdate solution has sufficient dispersion and stability for continuous destructive hydrogenation of coal. Coal hydrogenation experiments were performed in a rotating 0.5 l autoclave at 420-430° C, 2 hours, hydrogen pressure 10-12 MPa. Without the catalyst, the conversion of the organic mass reached 59.6%, the yield of liquid products, 69.8%. With 0.0025% molybdenum, conversion increased to 63.1%; increasing the molybdenum concentration increased conversion and liquid product yield. At 0.12% molybdenum, conversion increased to 79.0%, liquid product yield -- 86.3%. Sulfur contained in the coal cannot rapidly interact with hydrogen to form hydrogen sulfide and convert molybdenum compounds to sulfide during destructive hydrogenation of coal from this basin. This means that significant depth of conversion can be achieved only where the molar ratio of total oxides of calcium to total sulfur is significantly less than one. This requires introduction of sulfur, which is converted in hydrogenation to hydrogen sulfide and can be easily and practically completely regenerated. Figure 1, references 7: 6 Russian, 1 Western. [174-6508]

## INTERRELATIONSHIP OF STRUCTURAL-CHEMICAL PARAMETERS OF BROWN COAL WITH BASIC HYDROGENATION PROCESS CHARACTERISTICS

Moscow KHIMIYA TVERDOGO TOPLIVA in Russian No 5, Sep-Oct 85 (manuscript received 3 May 84) pp 53-57

KRICHKO, I.B. and KRENKOVA, T.M., Institute of Fossil Fuels

[Abstract] Based on a study of the molecular structure of brown coal, an attempt is made to estimate the interrelationship of the degree of transformation of the coal in hydrogenation and structural chemical parameters

characterizing the structure of the coal. Brown coal from the Berezovskiy deposit of the Kansk-Achinsk basin was hydrogenated in standard autoclave devices. The structural-chemical parameters reflecting the quantitative content of carbon, hydrogen and oxygen in individual structural groups of the coal were obtained by IR spectroscopy and a chemical analysis. The parameters and degree of transformation in hydrogenation are described by empirical equations relating the parameters characterizing the content of carbon in aliphatic  $\text{TH}_2$  groups in the condensed aromatic form, in phenol hydroxyls, oxygen and total carbon in the coal. The empirical equations obtained allow prediction of the behavior of the coal during destructive hydrogenation. Figures 2, references 11: 7 Russian, 4 Western.  
[174-6508]

UDC: 662.747

#### DYNAMICS OF GAS FORMATION DURING GASIFICATION OF COAL IN A FLUIDIZED BED UNDER PRESSURE

Moscow KHIMIYA TVERDOGO TOPLIVA in Russian No 5, Sep-Oct 85 (manuscript received 6 Sep 83) pp 83-87

NIKITINA, T.V. and CHERNENKOV, I.I., Institute of Fossil Fuels

[Abstract] There is a need for detailed study of the mechanism and dynamics of gasification of coal in a fluidized bed under pressure. It has been established that there are oxidative and reducing zones in such a bed as well as fuel-drying and low temperature carbonization zones. This article studies the dynamics of gas formation in these zones in a steady-state fluidized bed. Studies were performed on a continuous installation with a gas throughput of  $6 \text{ m}^3/\text{hr}$ . Gas was taken off through a tube with a long, narrow slot equipped with a cooling unit, allowing reliable and reproducible results. The transition from one zone to another characteristically was the locus of a maximum in the distribution of carbon dioxide concentration through the height of the fluidized bed. The major role in gas formation in the fluidized bed under pressure is played by the initial suction of the reducing zone. An increase in blowing speed decreases the concentration of flammable components in the gas, equalizing temperature through the height of the layer and increasing the length of the zones. Increasing pressure helps to reduce the length of the zones, increasing the intensity of the process and decreasing the necessary gas generator dimensions. Figures 3; references 9: 7 Russian, 2 Western.  
[174-6508]

## SOME PROBLEMS ON MECHANISM OF CATALYTIC HYDROGENATION OF CARBON BLACK

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 9 Jan 84) pp 2448-2450

USHAKOVA, G.I. and SHIRYAEV, V.K.

[Abstract] A direct experimental comparison is presented of the possible hydrogen atom transfer rate from metal to substrate resulting from roasting and the rate of chemical conversion and hydrogenation of carbon black in the presence of a platinum catalyst. Roasting was performed in a furnace at 700 or 850°C in a current of oxygen-free helium, after which the adsorption of carbon monoxide was measured by a chromatographic method. The rate of chemical conversion is found to be much greater than the possible rate of transfer due to heating of the platinum. This means that the catalytic effect of platinum in hydrogenation of carbon black is not related to recrystallization phenomena. In other words, the catalytic effect of platinum in this process cannot be related to the spillover effect. Figures 2; references 8: 3 Russian, 5 Western.  
[220-6508]

## ELECTROCHEMISTRY

UDC 541.12.036:541.138.3:546.98

### INFLUENCE OF HEATING IN ARGON ON PROPERTIES OF PALLADIUM ELECTRODE CATALYST

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85  
(manuscript received 14 Aug 84) pp 2599-2600

STEPINA, N.D., VOVCHENKO, G.D., deceased, PLETYUSHKINA, A.I., MASHKOVA, L.P.  
and CHERNYKH, T.Ye., Faculty of Chemistry, Moscow State University imeni  
M.V. Lomonosov

[Abstract] A study is made of the influence of heat treatment on adsorption and catalytic properties of palladium produced under various conditions of electrodeposition. In contrast to catalysts studied earlier, in this work during deposition of the palladium electrodes the solution of palladium chloride was agitated with a magnetic stirrer. 30-35 mg of palladium were precipitated on the electrode with specific surface  $1 \text{ m}^2/\text{g}$ . The influence of heating on the catalytic capability of palladium was studied in the reactions of electroreduction of a 0.4 M solution of maleic acid and a 0.4 M solution of nitromethane in 1 N sulfuric acid. Heating in argon was found to change the microstructure of the palladium and decrease its adsorption capacity for hydrogen. Figures 2; references 2 (Russian).  
[220-6508]

UDC 541.127:536.629

### LOCALIZED ELECTRON REACTION KINETICS ON SOLUTION OF SOLID DIELECTRICS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA in Russian  
No 5, Sep-Oct 85 (manuscript received 6 Jun 85) pp 596-602

TILIKS, Yu.Ye., KANTS, L.K. and DZELME, Yu.R., Latvian State University  
imeni P. Stuchka

[Abstract] Solution of solid dielectrics with localized electronic defects in solutions with electron acceptors led to both homogeneous and heterogeneous reactions. Specific analysis of the kinetics applicable to LiF, LiCl, NaF, NaCl,  $\text{K}_2\text{SO}_4$ ,  $\text{Na}_2\text{SO}_4$  and  $\text{Rb}_2\text{SO}_4$  subjected to gamma-irradiation to

impart electronic defects and dissolved in water containing ethanol, sulfuric acid and competing electron acceptors (nitrate, Fe(III), chloroacetate) demonstrated that the probability of occurrence of heterogeneous reactions was dependent on the characteristics of the matrix. The latter included the degree of defectiveness, rate of solution, and the nature of the electron acceptor. Mathematical equations are presented to model the chemical reactions of localized electrons and the products of their transformation in the course of solution. Figures 3; references 10: 9 Russian, 1 Hungarian (in English).  
[251-12172]

UDC 541.183;661.543.42

#### USE OF SPIN PROBE METHOD TO STUDY PARAMAGNETISM OF CARBON FIBERS

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85  
(manuscript received 23 Oct 84) pp 2633-2634

GRIGOREV, G.A., MAKAROV, I.G., BOBROVNIKOV, Yu.A. and BORODIN, A.N.,  
Moscow Institute of Precision Chemical Technology imeni M.V. Lomonosov

[Abstract] The spin probe method was used to study the nature of paramagnetism of carbon fibers. Polyacrylonitrile carbon fibers treated at 2673 K were used with 2,2,6,6-tetramethylpyridine-1-oxyl as the probe. The probe apparently bonds with a hole-type charge carrier in the carbon fiber, and the decrease in charge carrier concentration causes an increase in hole concentration, increasing paramagnetism. There is apparently transfer of charge from the adsorbed radicals into the volume of the carbon fiber or diffusion of adsorbed radicals into the space between filaments. Figure 1; references 3 (Russian).  
[220-6508]

UDC 535.241.13.532.783

#### SPACE-TIME MODULATION OF LIGHT BY ORGANIC POLYMER PHOTOCONDUCTOR -- LIQUID CRYSTAL STRUCTURE

Leningrad ZHURNAL TEKHNIЧЕСKOY FIZIKI in Russian Vol 55, No 4, Apr 85  
(manuscript received 23 Apr 84) pp 749-751

MYLNIKOV, V.S., MOROZOVA, Ye.A., VASILENKO, N.A., KOTOV, B.V. and  
PRAVEDNIKOV, A.N.

[Abstract] An attempt was made to substitute organic polymer photoconductor for expensive inorganic crystals, polycrystalline films and glassy photoconductors used normally in space-time modulators of light. Polyvinylcarbazol, polyepoxyvinylcarbazol and polyimides were evaluated. The polyimides were



found to be the most satisfactory replacements. The system was evaluated by determining the S-effect and cholesterine-nematic transition. The ability to use polyimide films in these systems represented an achievement of the goal of this work. Figures 2; references 6 (Russian).  
[226-7813]

## FERTILIZERS

### COMPUTER DATA USED TO IMPROVE HARVEST IN SIBERIA

Moscow EKONOMICHESKAYA GAZETA in Russian No 43, Oct 85, p 5

[Article: "The Harvest is Programmed"]

[Text] The collective of the Siberian Plant Physiology and Biochemistry Institute of the Siberian Oblast of the USSR Academy of Sciences, in addition to the development of fundamental studies, is engaged in the introduction of scientific cultivations into practice. One of the directions of the introductory activity of the institute is a method for programming the harvest, which coworkers of the agrochemistry laboratory are developing. Work on a balanced feeding and efficient use of fertilizers was conducted in the fields of the Way to Communism Kolkhoz in the Tayshet rayon. The harvest of agricultural cultivation rose by 50-80 percent. Computers are employed in order to use the whole system of organizational-economic measures for forecasting the harvest more efficiently. A data bank has already been established which enables the harvest in all economies of the rayon to be programmed.

12410

CSO: 1841/196

UDC: 631.81.095.337:631.589.2

USE OF TRACE ELEMENTS IN VEGETABLE FARMING IN SHELTERED SOIL

Moscow AGROKIMIYA in Russian No 9, Sep 85 pp 131-137

TCHUPRIKOVA, O.A. RYABYKH, R.S. and YAKOVLEVA, N.N.

[Abstract] This literature review reports briefly on the value of utilization of trace elements in greenhouse soils in which vegetables are grown. Proper construction of a nutrient system for plants in such soils is impossible without including fertilizers containing trace elements which perform various functions in the plants, changing the rate of oxidation-reduction processes, positively influencing photosynthesis, participating in protein metabolism, influencing water conditions, the composition of enzymes and vitamins. Sufficient quantities of trace elements increase the resistance of plants to disease, improve the development of root systems, vegetative and reproductive organs of plants and increase the harvest, improving its quality. Many examples are cited in which presence of trace elements in numerous plants has been reported to improve nutritional value, increase yields, and improve the resistance of plants to various diseases. No experiments are described in sufficient detail to allow critical evaluation of the growing results presented. It is noted that the use of fertilizers containing trace elements must be carefully monitored since vegetables may accumulate many trace elements in significant quantities, close to the toxic quantities for humans. References 42: 29 Russian, 13 Western.

[171-6508]

INFLUENCE OF INCREASING DOSES OF MINERAL FERTILIZER, LIQUID AND SOLID MANURE  
ON RESISTANCE OF BARLEY TO ROOT ROT

Moscow AGROKHIMIYA in Russian No 9, Sep 85 (manuscript received 3 Jul 84)  
pp 84-93

MINEYEV, V.G., BELOUSOVA, N.A. and DURYNINA, Ye.P., Moscow State University

[Abstract] The purpose of this work was to study the influence of a number of factors including mineral fertilizer dose on the resistance of barley to root rot in chernozem and soddy-podzolic soils and to show the influence of manure on the status of various soils under various moisture conditions. The study of the influence of the fertilizers was conducted during the second year of their application. Field experiments were performed in 1981-1983 in soddy-podzolic soils (Moscow Oblast) and chernozem soils (Belgorod Oblast). The field experiments showed that root rot in lightly cultivated soddy-podzolic soil was somewhat higher than in moderately cultivated soil, which was related to the physiological resistance of the plants to the disease in the soils. Manure decreased root rot during all years of the study, particularly during dry years. Increasing the dose of phosphorus in the mineral fertilizer from 120 to 240 kg/ha did not result in a statistically-reliable decrease in root rot. Increasing nitrogen from 180 to 240 kg/ha did not result in any increase in root rot as long as normal moisture conditions were maintained. Organic fertilizer, solid or liquid manure, resulted in a consistent decrease in root rot and in the infectious potential of chernozem soils. The effect was less beneficial in the infertile soddy-podzolic soils. Fertilizers were most effective under dry conditions. Figures 3, references 25: 14 Russian, 11 Western.  
[171-6508]

UDC: 631.84:542.75

USE OF NITROGEN FERTILIZERS AND REGULATIONS OF NITRATE CONTENT IN PLANTS

Moscow AGROKHIMIYA in Russian No 9, Sep 85 (manuscript received 5 Nov 84)  
pp 6-15

SEMENOV, V.M., KNOP, K., AGAYEV, V.A., MATULA, I., BALIK, I., MATOUSH, O. and SOKOLOV, O.A., Institute of Soil Science and Photosynthesis, USSR Academy of Sciences, Pushchino, Moscow Oblast; Institute of Agriculture, Prague, Czechoslovakia

[Abstract] The purpose of this work was to study the influence of nitrogen fertilizers of the accumulation of nitrates in vegetables and feed crops as a function of the combination of doses and the methods of application and the use of nitrification inhibitors, as well as the significance of soil nitrogen and fertilizers in the formation of the nitrate pool of plants.

Studies were performed in 1982, 1983, in moderately loamy gray forest soil in Moscow Oblast and also in vegetation and field experiments in moderately-loamy brown soil in Czechoslovakia. The gray soil had pH 5.3, humus 2.3%, total nitrogen 0.13%, Hg 2.5 meq/100g,  $P_2O_5$  11.3 mg/100 g,  $K_2O$  9.1 mg/100 g. The brown soil had: pH 6.9, humus 1.7%, total nitrogen 0.11%,  $P_2O_5$  21.1 mg/100 g,  $K_2O$  16.8 mg/100 g. Local administration of ammonia-forms of nitrogen fertilizer and the use of nitrification inhibitors increased the use of fertilizer nitrogen by plants, increasing their productivity and helping to decrease the nitrate content in the products. The fertilizer nitrogen utilization factor for vegetables and feed crops with local application of ammonium nitrogen and the use of the didin nitrification inhibitor increased by an average of 5 to 16%. The content of nitrates in the plants decreased upon localization of nitrogen fertilizers in comparison to the broadcast method by an average of 1.7 times, while the nitrification inhibitor caused a decrease by a factor of 2.4. Isotope analysis of nitrate nitrogen indicated that the nitrate pool of the vegetable crops, when nitrogen fertilizers are used, is formed primarily of the soil nitrogen assimilated by the plants during vegetation. Figures 3, references 32: 16 Russian, 16 Western.  
[171-6508]

UDC: 631.85:631.445.24

#### EFFECTIVENESS OF MECHANICALLY ACTIVATED PHOSPHORITES ON SODDY-PODZOLIC SOIL

Moscow AGROKHIIMIYA in Russian No 9, Sep 85 (manuscript received 23 Nov 84)  
pp 21-27

YANISHEVSKIY, F.V., KOZHEMYACHKO, V.A. and POLYAKOVA, G.V., "Minudobreniya"  
Scientific-Production Association, Moscow

[Abstract] Results are presented from a study of the agrochemical effectiveness of phosphorites activated by various mechanical methods in vegetation experiments in soddy-podzolic medium loam soil, either unlimed or limed to various pH values. The phosphate condition of the soil was studied. The work was performed at the Ramenskaya agrochemical experimental station. Effectiveness is somewhat higher in soil at pH 4.6 than in non-activated soil. In limed soil at pH 5.4 and 6.1, activated phosphorites had no advantage over unactivated specimens. Activation was thus found to have no significant influence on the effectiveness of phosphates in the assimilation of phosphate by plants in the limed soil. Figure 1, references 17: 16 Russian, 1 Western.  
[171-6508]

IMPROVING SEED TREATMENT QUALITY

Moscow ZASHCHITA RASTENIY in Russian No 8, Aug 85 pp 24-25

STRASHNOVA, T.T., Chief Technologist, Agriculture Administration, RSFSR  
Ministry of Agriculture

[Abstract] Treatment of seeds with water-soluble polymer-based film-forming agents is widely used for corn, winter and spring grains, sunflowers, cotton, legumes and other crops. The volume of seeds treated by the new technology has increased in three years from 40 to 500,000 tons. The author calls for production of film-forming preparations in ready-to-use form. Special machines are also required for the process. The results of five-year experiments performed at the All-Union Scientific Research Institute of Corn indicate that film-forming polymers do not have fungicidal or phytotoxic effects, but can decrease mold damage to sprouting seeds by a factor of 2.5-3.5, reducing damage to sprouts by stem rot by a factor of 2-4 and wire worn damage by a factor of 4-7. The sprouting percentage is increased by 7-10%.

[145-6508]

## FREE RADICALS

### LOW TEMPERATURE TRANSFORMATION OF HYDROCARBONS IN PRESENCE OF HYDROGEN PEROXIDE ON OXIDE CATALYSTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 285, No 3, Nov 85 (manuscript received 12 Feb 85) pp 671-674

ELCHYAN, A.M., GRIGORYAN, G.L. and NALBANDYAN, A.B., academician ArSSR Academy of Sciences

[Abstract] Oxidation of  $\text{CH}_4$  and  $\text{C}_3\text{H}_8$  with  $\text{H}_2\text{O}_2$  to  $\text{CH}_3\text{OH}$  in the presence of  $\text{SiO}_2$  and  $\gamma\text{-Al}_2\text{O}_3$  as catalysts was studied. The optimum temperature was  $448^\circ\text{K}$ , pressure 88 kPa, and  $\text{H}_2\text{O}_2$  partial pressure 0.51 kPa. Figures 3; references 7: 6 Russian, 1 Western.  
[219-12928]

## INORGANIC COMPOUNDS

### NEW CERAMIC INSULATORS

Riga NAUKA I TEKHNIKA in Russian No 8, Aug 85 p 5

[Article by V. Masin: "Ceramics for Industry"]

[Text] A new type of electric ceramic material has been manufactured at the Riga Polytechnic Institute imeni A. Pelshe. The material's composition and technology for its manufacture were worked out by specialists at the Institute's Scientific-Research Problem Laboratory for Glass and Ceramics of the Chemistry Division.

The new ceramic material is intended for the manufacture of electric insulator construction elements in devices used for the vacuum condensation of magnesium. Such parts have been manufactured and incorporated into the Design and Construction Bureaus for Vacuum Coatings of the LaSSR Gosplan. Tests have demonstrated that these materials are superior to their analogs in that they can be used at higher temperatures (they can withstand temperatures up to 1000°C) and they have better electrical insulation properties. Their specific electrical resistance at 100°C is  $2 \cdot 10^9$  Ohms.m. The new ceramic material firmly withstands temperature fluctuations and the effects of alkalis, and it is practically inert to the corrosive effects of magnesium vapors. Moreover, its production is relatively inexpensive because waste products of the silicate industry — rubble from cistern refractory materials — are utilized to manufacture this material.

These properties predetermine the possible use of this new ceramic material in the chemical machine-building and electrical equipment industries. The predicted economic gain from the national economic use of just the magnesium condensation equipment alone, manufactured from this new type of ceramic electrical insulation, comes to approximately 300,000 rubles per year.

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CSO: 1841/204



## DEPENDENCE OF SPECIFIC SURFACE AREA OF POROUS SILICON ON PARAMETERS OF ANODIC TREATMENT AND HIGH-TEMPERATURE ANNEALING

Moscow POVERKHNOST: FIZIKA, KHIMIYA, MEKhanIKA in Russian No 10, Oct 85  
(manuscript received 25 Oct 84; in final version 25 Jan 85) pp 64-69

BONDARENKO, V.P., DOROFYEV, A.M. and TABULINA, L.V., Minsk Institute of  
Radio Engineering

[Abstract] An experimental study of porous silicon for electronic engineering applications was made, the purpose being to determine the dependence of its specific surface area on the parameters of anodic treatment by which it is produced from single crystals and on the parameters of subsequent high-temperature annealing. Single crystals grown by the Czochralski method with (111)-plane orientation were uniformly doped with antimony to a concentration of  $4 \cdot 10^{18}$  Sb atoms/cm<sup>3</sup>. Porous layers of 10-80  $\mu$ m thickness and 1.2-1.8 g/cm<sup>3</sup> density were produced by anodic treatment in aqueous 12% HF and 18% HF solutions at current densities of 5-20 mA/cm<sup>2</sup>. Wafers with such layers were then annealed at 1000°C and at 1200°C for 30 min in a hydrogen atmosphere. The specific surface area was measured by the method of nitrogen adsorption isotherms, at a constant temperature of 77 K but with the relative nitrogen pressure varied over the 0-0.1 range. The experimental data were evaluated on the basis of the Brunauer-Emmet-Teller equation. The structure of porous silicon was examined under two electron microscopes, the surface microrelief under an EMMA-2 microscope with 2-stage replicas and the internal structure under a JSM-50A raster microscope. The diameter of pores was found to increase somewhat with increasing HF concentration in the electrolyte for anodic treatment. The density of pores was found to decrease with increasing HF concentration and to increase somewhat with increasing current density. The results pertaining to the kinetics of porosity development are interpreted in terms of the capillary model. High-temperature heat treatment evidently results in a restructurization of porous silicon with an attendant decrease of its specific surface area, caused by recrystallization and sintering. Initial sintering causes small pores to "collapse" into isolated cavities, further heating causes formation of large pores where the vacancy concentration is higher. At the surface, this mechanism of pore enlargement is countered by a mechanism of pore diminution, namely migration of vacancies toward the outer surface and thus toward what can be regarded as the largest pore. Further annealing retains the porosity of silicon, but isolated cavities

except those at cleavage surfaces do not contribute to nitrogen adsorption under compression so that the specific surface area becomes effectively smaller than before annealing. Figures 4; references 13: 4 Russian, 9 Western (1 in Russian translation).  
[195-2415]

## NITROGEN COMPOUNDS

UDC 662.613.5

### NITRIC OXIDES IN FUEL COMBUSTION PRODUCTS AND IN FREE AIR

Kiev KHIMICHESKAYA TEKHNLOGIYA in Russian No 5, Sep-Oct 85 (manuscript received 3 Jun 85), pp 54-56

[Article by I.Ya. Sigal of the Gas Institute, UkSSR Academy of Sciences, Kiev: "Nitric Oxides in Fuel Combustion Products and in Free Air"]

[Text] The gross emission of nitric oxides into free air in various regions and cities usually comprises from 6 to 8 percent of the total emission of all harmful substances, second only to the emission of carbon monoxide, sulfur oxides, and solid particles. However, considering the higher toxicity of  $\text{NO}_2$  ( $\text{PDK}_{\text{gr}}$  [maximum permissible concentration] is  $0.085 \text{ mg/m}^3$ , compared with  $0.5 \text{ mg/m}^3$  for  $\text{SO}_2$  and dust, and  $5 \text{ mg/m}^3$  for CO) and the active participation in photochemical reactions in the atmosphere, nitric oxides are not inferior to these three groups in their effects. Together, these four leading groups of pollutants make up from 90 to 98 percent of the pollution of the air in almost all cities.

Previously, from 50 to 55 million tons a year of nitric oxides were released into the Earth's atmosphere, mainly in fuel combustion. Nitric oxides are formed during the combustion and explosion of all fuels, without exception. Even at enterprises of the chemical industry the emission of nitric oxides, formed when fuel burns in boilers and furnaces, significantly exceeds their emission in the manufacture of nitrogen fertilizers.

Many years of research, conducted at the Gas Institute, UkSSR Academy of Sciences, made it possible to roughly determine the concentration of harmful substances given off with the products of fuel combustion in boilers used in enterprises of the chemical industry (Table 1 [1]).

Prior to 1980, all research into the formation of nitric oxides in combustion processes was based on the following premises: only nitric oxide is formed in the process of burning fuel in boilers and other fuel-burning devices; when exhausted from the stack the nitric oxide comparatively rapidly and completely undergoes further oxidation to nitrogen dioxide ( $\text{NO}_2$ ).

Along with this, research of the Belorussian department of VNIPI Energoprom [All-Union Scientific Research and Design Institute Energoprom] [2], Gas Institute of the UkSSR Academy of Sciences [3, 4], and Main Geophysical

Table 1. Concentration of toxic substances in combustion products ( $\text{g}/\text{m}^3$ ) exhausted into the atmosphere when burning various types of fuel in boilers.

(1) Токсичное вещество	(2) Паропроизводитель- ность котла, т/ч пара	(3) Каменный уголь ( $S^P=1.7\%$ )	(4) Мазут ( $S^P=2.3\%$ )	(5) Природный газ
(6) Оксиды серы (в пересчете на $\text{SO}_2$ )	—	3.0	4.0	(13) Следы
(7) Оксиды азота (в пересчете на $\text{NO}_x$ )				
I	170—230	0.25—0.50	0.20—0.30	0.25—0.40
II	10—170	0.25—0.40	0.25—0.35	0.20—0.30
(8) Зола, пыль	10—230	0.06*—2.0	0.07—0.35	0.0—0.070
(9) Оксид углерода (CO)	20—230	0.02—0.30	0.050—0.50	0.01—0.10
(10) Альдегиды (в пересчете на $\text{CH}_2\text{O}$ )	10—230	—	0.007—0.07	0.004—0.04
(11) Сажа (C)	10—230	0.035—0.070	0.001—0.100	0.0075—0.015
(12) Бенз(а)пирен ( $\text{C}_{20}\text{H}_{12}$ )	170—230	$(10-50) \cdot 10^{-8}$	$(2-30) \cdot 10^{-8}$	$(0-2.0) \cdot 10^{-8}$

\* Lower limit is when a dust collecting system is present.

Key:

- |   |  |
|---|--|
| 1. Toxic substance                            | 8. Ash, dust                                       |
| 2. Boiler rating, t/hr steam                  | 9. Carbon monoxide (CO)                            |
| 3. Bituminous Coal ( $S^P = 1.7\%$ )          | 10. Aldehydes (in terms of $\text{CH}_2\text{O}$ ) |
| 4. Fuel oil ( $S^P = 2.3\%$ )                 | 11. Soot (S)                                       |
| 5. Natural gas                                | 12. Benzpyrene ( $\text{C}_{20}\text{H}_{12}$ )    |
| 6. Sulfur oxides (in terms of $\text{SO}_2$ ) | 13. Traces   |
| 7. Nitric oxides (in terms of $\text{NO}_x$ ) |  |

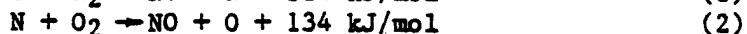
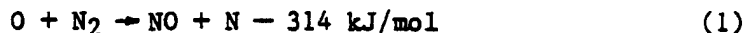
Observatory [5] showed that only 40 to 80 percent of the nitric oxide contained in the stream of smoke is converted to nitrogen dioxide. In conjunction with works on the validity of the PDK for  $\text{NO}$ , carried out at the Belorussian Medical Institute, the USSR Minzdrav [Ministry of Health] in 1982 approved the following PDK values ( $\text{mg}/\text{m}^3$ ) for nitric oxides in the free air of populated areas:

	Maximum One-time PDK	Average Daily PDK
Nitrogen dioxide	0.085	0.04
Nitric oxide	0.6	0.06

The introduction of the maximum one-time PDK for nitric oxide and nitrogen dioxide, differing from the norm, was enhanced by the requirement to study the conditions of formation not only of nitric oxide during combustion, but also its conversion to dioxide. Reference 1 presents the results of an analysis of our data and works by other organizations on the study of formation conditions for nitric oxide in furnaces.

Based on the available results of multifaceted laboratory and industrial studies, it can be pointed out that nitric oxide is formed in the combustion zone of all fuel by three different mechanisms.

1. Thermal -- as the result of dissociation of molecules to atoms and radicals, and the subsequent oxidation of the nitrogen molecule (Ya.B. Zel'dovich mechanism [6]):



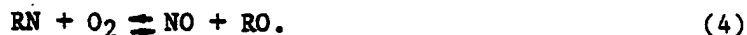
This mechanism is based on the great dependence of NO output on temperature, which qualitatively is confirmed by studies at large full-scale plants. It can be quantitatively refined by taking into account data on NO formation time and superequilibrium concentrations of O, H, and OH in the flames [7].

2. The rapid mechanism, operative at the start of the combustion zone (the Fenimore mechanism [8]), on the basis of which the following reaction was assumed:



having a very mild dependence on temperature (or via the  $\text{CH}_2$  radical). This mechanism determines the minimum output of NO in the combustion zone of gas fuel. The output of "rapid"  $\text{NO}_x$  strongly depends on the type of fuel: for example, when burning methane it will be one order higher than when burning hydrogen.

3. Fuel mechanism, by which the nitrogen of the fuel converts to compounds of the type CN, CHN, NH,  $\text{NH}_2$ , and then it is partially oxidized to nitric oxides when burning fuels that have nitrogen-containing compounds (for example Kansko-Achinskiy, Ekibastuzskiy, and other coals) ( $\text{NP} = 0.8\text{--}1.5\%$ ) and fuel oils, [9, 10]:



The effect of the fuel mechanism and the density of the rapid NO is more significant at the comparatively lower temperatures of  $T_{\text{max}} < 1900 \text{ K}$ . Based on the available data, it is possible to construct a very rough chart reflecting the portion of the nitric oxides formed by the various mechanisms when burning nitrogen-containing fuels (Figure 1). When flame-burning gas in boiler furnaces, nitric oxide is formed by two of the mechanisms mentioned above (in this case, thermal and rapid). In some instances, for example, burning coal in a fluidized bed (only "fuel"  $\text{NO}_x$ ) or burning gas in small units (an advantage of "rapid"  $\text{NO}_x$ ), nitric oxides are formed by one of the three mechanisms mentioned. This, to a significant degree, applies to high-temperature combustion at  $T_{\text{max}} > 2200 \text{ K}$ , where the leading mechanism is "thermal" and  $\text{NO}_x$  formation by the two other mechanisms is not quantitatively significant. Moreover, when burning fuels not only NO forms, but also nitrogen dioxide  $\text{NO}_2$ .

It is known, for example, that the brown color of flue gases is visible in the exhaust of gas turbines, indicating a high concentration of  $\text{NO}_2$ . Studies conducted over the last five to seven years [11] have shown that the partial

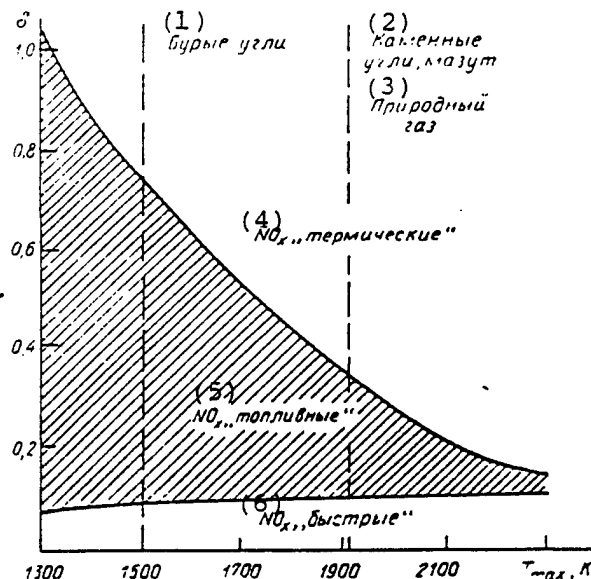


Figure 1. Approximate ratio of nitric oxides formed by the different mechanisms when burning nitrogen-containing fuels.

Key:

- |                              |                            |
|------------------------------|----------------------------|
| 1. Lignite                   | 4. "Thermal" $\text{NO}_x$ |
| 2. Bituminous coal, fuel oil | 5. "Fuel" $\text{NO}_x$    |
| 3. Natural gas               | 6. "Rapid" $\text{NO}_x$   |

oxidation of NO to  $\text{NO}_2$  occurs in the cooler part of the flame, or near the walls of the furnace. The reaction of a hydrogen atom with an oxygen molecule can occur in two directions [12]:



or



The latter method of forming the active oxidizer of the peroxide radical  $\text{HO}_2$  becomes more likely at temperatures between 800 and 1200 K.

The concentration of  $\text{HO}_2$  radicals forming at these temperatures is in the tens--and even hundreds--of  $\text{mg/m}^3$ , commensurate with the concentrations of NO, and is sufficient for oxidation of a substantial part of it to dioxide by the reaction



The portion of  $\text{NO}_2$  in the fuel combustion products changes from 3 to 5 percent in power-generator boilers to 20 to 30 percent in heating boilers [11], gas turbines [13], and automobile engines at idle [14]. The portion of  $\text{NO}_2$  in smoke gases increases with a rise in excess of air; with growth in degree of cooling of the furnace chamber, e.g., with decrease in its dimensions [11],

a decrease in furnace loading; and with an increase in pressure in the furnace [13]. In conjunction with the separate normalization of NO and NO<sub>2</sub> in the atmosphere, the urgent tasks arise of determining the concentration of NO<sub>2</sub> in free air and its portion of the total nitric oxides (Figure 2).

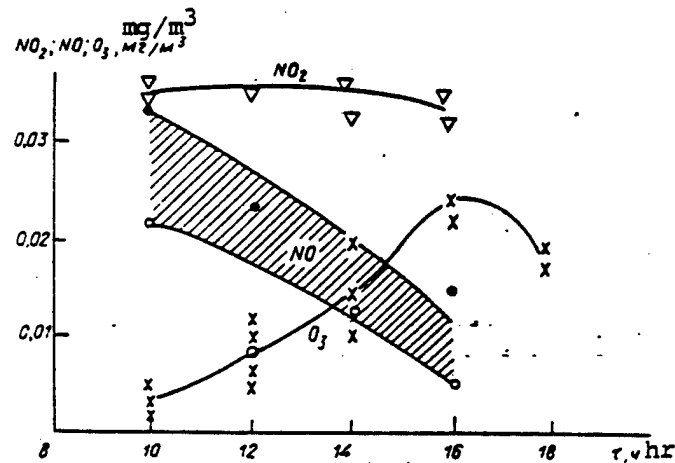


Figure 2. Content of NO, NO<sub>2</sub>, and O<sub>3</sub> at a height of 1.5 m in city air in an area of limited effects from automobile traffic (within a city block).

The amount of NO<sub>2</sub> diluted in the smoke stream determines the concentration of NO<sub>2</sub> in free air, as well as the NO<sub>2</sub> formed in free air through the oxidation of oxygen, mainly by ozone contained in the air [4].

Figure 2 shows some concentrations at a distance of 40 m from the main highway. Here, the extreme curve of the ozone concentrations, with the maximum during maximum solar radiation (measurements were taken in October at 11 to 14°C) is characteristic. As is evident, all the values are below the maximum allowable concentrations -- PDK<sub>mr</sub>.

Experimental data on the portion of NO<sub>2</sub>

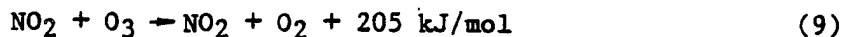
$$\overline{\text{NO}_2} = \frac{\text{NO}_2}{\text{NO}_2 + \text{NO}} 100\% \quad (8)$$

in the city air for that time period, obtained over a number of days, is shown below:

Time	1000	1200	1400	1600
NO <sub>2</sub> , %	46-65	59-74	65-78	70-83

There was often a point of higher NO concentration, from five to seven times higher than the NO<sub>2</sub> content, near highways (distance less than ten meters) during the daytime hours [15].

The dioxide content in the air ultimately is determined by the rate of reactions

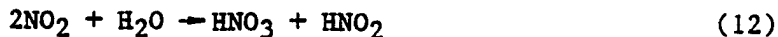


and photolysis reactions of ozone formation .



ongoing in sunlight.

Usually, nitric oxides are in the air for three to five hours, shifting with the airflows to a distance of up to 1,000 km. They then discharge from the air into the water and soil when combined with drops of water, mainly in the form of weak solutions of nitric and nitrous acids



Unfortunately, these substances fall to the ground with rain not in the places, not at the times, and not in the amounts where they can be beneficial, but are a significant hazard to plants, especially since NO<sub>2</sub> intensifies the harmful effects of sulfurous anhydrides on them, and nitric acid burns the leaves of plants.

In recent years in many institutes of the country, a large package of work has been carried out on studying the conditions of formation of, and developing the methods to reduce the formation of, nitric oxides. We shall dwell on several of them, stemming from work at the Gas Institute, UkSSR Academy of Sciences.

Research in recent years has made it possible to recommend tested methods to reduce the formation of nitric oxides in boilers operating on gas and fuel oil. In the Gas Institute, burners with internal mixing of recirculation gases with forced air have been developed and used. These burners are being used in several TGMP-314A gas-fuel oil boilers and make it possible to reduce NO<sub>x</sub> formation by half. Similar designs and systems can also be used for boilers in commercial enterprises. However, feeding recirculation gases can yield substantial results only if they are preliminarily mixed with air in the air duct or in the burner prior to combustion. The withdrawal of flue gases for recirculation should be from 12 to 20 percent of the total consumed from the region with temperatures of from 300 to 380°C (ahead of the boiler's air preheater).

Two-stage combustion burners were developed and used in a number of PTVM-50 boilers, and were also tested in PTVM-100 experimental boilers, making it



possible to reduce NO formation 1.7- to 2-fold: for example, in the PTVM-50 boilers -- from 240-390 mg/m<sup>3</sup> to 145-175 mg/m<sup>3</sup>.

Between 1986 and 1987 the PTVM boilers at the Dneprodzerzhinsk PO [Production Association] Azot will be equipped with these burners. These measures can be used in a number of boilers and power plants of chemical enterprises.

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12304

CSO: 1841/134

## ORGANOMETALLIC COMPOUNDS

### METHOD FOR SYNTHESIZING ORTHOQUINONE COMPOUNDS

Moscow IZVESTIYA in Russian 13 Sep 85 p 2

[Article by V. Goldanskiy, academician and Lenin Prize laureate: "From Hydrogen to Uranium"]

[Text] Works which are devoted to clarifying general properties of elements and which lead to obtaining new substances are always great events in chemistry. Such an event was the cycle of works (1971-1983) by the USSR Academy of Sciences Chemistry Institute (Gorkiy) and the USSR Academy of Sciences Elementoorganic Compounds Institute (Moscow), "The Synthesis, Construction Reactive Properties and Use of Orthosemiquinone Complexes of Transition and Nontransition Elements."

It has been known that the majority of elements form complex compounds. The latter are used, for example, during purification of precious metals as catalysts for chemical reactions, and play an important role in biological processes.

In the research under discussion complex compounds were obtained principally in the form of a new type, in which to the atom of the element unstable particles are attached—free radicals. Because of the rapid destruction of these particles, their isolation in pure form is extremely difficult, and only recently the existence of such compounds seemed impossible.

The theoretical prerequisite for their synthesis was the concept that the formation of complexes should increase the stability of the free radicals. Particles have been found that are capable of being preserved in compounds with various elements. Orthosemiquinone free radicals possess such properties, distinguished from others by their structural features.

The organic substances—orthoquinones—constitute the basis of the synthesis of the new compounds. Solving practical questions, the authors of the work synthesized new orthoquinones, which are distinguished by oxidizing properties. The synthesized complexes are easy to distinguish in pure form and are of great interest as active materials.

The new substances obtained possess unusual properties. Thus, some of them possess intrinsically an intermolecular movement of atoms which result in their magnetic characteristics changing reversibly. Another interesting property has been discovered during research on complexes of metals with variable valence. The authors obtained properties in these substances (magnetism, color, etc.) which became sharply changed during weak internal activity.

Such sensitivity has found important practical application. As an example, one may put to use the fine, thread-like crystals of metal complexes with variable valence in creating high-sensitivity measurements of weak heat and light currents, as well as a distance temperature recorder. A unique thermomechanical effect is at the basis of the effectiveness of the instrument: heat and light streams insignificant in intensity cause a reversible deformation of crystals. Other practically important results have also been discovered. Promising methods have been developed for direct synthesis of chemical compounds from simple substances and orthoquinone for waste-free technology, and for the solution of certain metals in organic media with their subsequent precipitation on various surfaces for obtaining coatings. The bright color of complexes is used in creating photographic images.

The theoretical significance of this work consists in the fact that for the first time a link has been established between the chemistry of free radicals and coordinated chemistry developed earlier by completely independent means.

Widely known both in our country and abroad, this cycle of works has meritoriously been advanced for competition for the USSR State Prize.

12318  
CSO:1841.26

## SIXTH EUROPEAN CONFERENCE ON METALLOORGANIC CHEMISTRY

Riga SOVETSKAYA LATVIYA in Russian 18 Sep 85

[Article "Boundaries of Metalloorganicists"]

[Text] In Yurmala on 17 September the Sixth European Conference on Metalloorganic Chemistry opened. Its participants represent scientific centers of Bulgaria, Hungary, German Democratic Republic, Poland, the Soviet Union, Czechoslovakia, Austria, Great Britain, Spain, Italy and a number of other countries on the continent. There are also guests from Canada, the USA and Japan. The main organizers of the scientific forum were the USSR Academy of Sciences and the Federation of European Chemical Societies.

The Chairman of the Soviet Organizing Committee, USSR Academy of Sciences Corresponding Member M.Ye. Volpin, opened the conference.

Chairman of the International Organizing Committee, Professor Stanislaw Pasynekevich (Polish People's Republic), wished those assembled success in their work.

Warm words of greeting were addressed at the conference to its honorary chairman, one of the leading figures in metallorganic chemistry, Soviet Academician G.A. Razuvaev, with regard to his 90th birthday.

At the first plenary session a number of summary reports were heard, given by Soviet and foreign scientists.

The program of discussions has been scheduled for five days.

"If you consider that in the world several millions of organic substances have been synthesized, it is difficult even to imagine the number of possible variants of their combination with metals," said deputy chairman of the Soviet organizing committee, corresponding member of the Latvian SSR Academy of Sciences, E. Ya. Lukevits. "These compounds, which possess diversity and sometimes unexpected properties, played a prominent role in the development of modern chemical science and industry. Based on them, highly effective reagents and catalysts have been created, without which it would

have been impossible to imagine many technological processes, including those related to the production of polymer materials and medicines."

Today, metalloorganicists are on the cutting edge of science, and the problems solved acquire an increasingly important significance for the domestic economy. The scientists working in this area are engaged, for example, in such actual problems as fixing atmospheric nitrogen. Theoretical and experimental research which has been conducted open alluring prospects before the fertilizer industry and several other branches. Original methods for obtaining highly pure metals, high-melting and other compounds, have been of interest for the new technology.

As it has been made clear, certain molecules of organic substances which include metals are distinguished by a high biological activity and may show medicinal effect. Incidentally, similar compounds exist in nature as well. This includes hemoglobin, which participates in respiratory processes, vitamin B-12, and individual enzymes. Now they are looking for metalloorganic curative preparations, never before adapted for medicine. It is anticipated that they soon will reinforce available means against tumors, pathogenic fungi, bacteria, and viruses. This scientific trend is developing, in particular, at the Institute of Organic Synthesis of the Latvian SSR Academy of Sciences.

Metalloorganic research encompasses a wide area. In our country the collectives of the USSR Academy of Sciences Elementoorganic Compounds Institute imeni A.N. Nesmeyanov and the USSR Academy of Sciences Chemistry Institute (Gorkiy) lead the research. The majority of reports presented at the conference were prepared by Soviet scientists.

12318

CSO: 1841/26

UDC 541.12.011.2:542.61:547.442.3-38:547.962.3

STUDY OF SOLID-PHASE DISSOLUTION OF IRON ACETYLACETONATE BY GAMMA RESONANCE

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 3 Jan 84) pp 2491-2494

GUSAKOVSKAYA, I.G., PIRUMOVA, S.I. and OVANESYAN, N.S., USSR Academy of Sciences, Institute of Chemical Physics, Chernogolovka

[Abstract] A gamma resonance method was used to study the specifics of dissolution of hydrophilic  $\text{Fe}^{\text{III}}$  acetylacetonate in human serum albumin and silica gel matrices. Solid-phase dissolution of the crystals, in contrast to hydrophobic crystals, involves the formation of a new Mossbauer label complex on the surface of the serum albumin, indicating that rapid dissolution of the polycrystals results from chemical interaction of molecules of the label from the gas phase with the hydrated protein surface. Figures 2; references 6: 5 Russian, 1 Western.  
[220-6508]

## ORGANOPHOSPHORUS COMPOUNDS

### EFFECT OF STRUCTURE OF DIBASIC PHOSPHORORGANIC COMPOUNDS ON THEIR EXTRACTION ABILITY

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 285, No 1, 1985, pp 165-170

ROZEN, A.M., member-correspondent of SSSR Academy of Sciences NIKIFOROV, A.S., NIKOLOTOVA, Z.I., KARTASHEVA, N.A., STUDNEV, Yu.N., CHAUZOV, V.A., academician FOKIN, A.V.

[Abstract] Extraction of americium and other actinides from their  $\text{HNO}_3$  solutions with  $(\text{iso-C}_8\text{H}_{17}\text{O})_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_2\text{H}_5)_2$ ,  $(\text{iso-C}_5\text{H}_{11}\text{O})_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{C}_8\text{H}_{17})_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{C}_6\text{H}_5)_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{C}_6\text{H}_4\text{CH}_3)_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{C}_6\text{H}_5)_2\text{P}(\text{O})\text{CH}_2\text{P}(\text{O})\text{N}(\text{C}_8\text{H}_{17})_2$ , and  $(\text{C}_6\text{H}_5)_2\text{P}(\text{O})\text{CH}_2\text{P}(\text{O})(\text{C}_6\text{H}_5)_2$  dissolved in dichloroethane, benzene, and chloroform was studied. The degree of extraction of americium decreased in the following order  $(\text{C}_6\text{H}_5)_2\text{P}(\text{O})\text{CH}_2\text{P}(\text{O})(\text{C}_6\text{H}_5)_2$ ,  $(\text{C}_6\text{H}_5)_2\text{P}(\text{O})\text{CH}_2\text{P}(\text{O})(\text{C}_8\text{H}_{17})_2$ ,  $(\text{C}_6\text{H}_4\text{CH}_3)_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{C}_6\text{H}_5)_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{C}_8\text{H}_{17})_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{iso-C}_5\text{H}_{11}\text{O})_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_4\text{H}_9)_2$ ,  $(\text{iso-C}_8\text{H}_{17}\text{O})_2\text{P}(\text{O})\text{CH}_2\text{C}(\text{O})\text{N}(\text{C}_2\text{H}_5)_2$ . Equations describing the extraction and extraction coefficients are also given. Figures 4; references 15: 11 Russian, 4 Western. [166-12928]



PESTICIDES

UDC: 632.954:581.1

EFFECT OF HERBICIDE ROSALINE ON PHOTOCHEMICAL ACTIVITY OF CHLOROPLASTS OF  
RESISTANT AND NONRESISTANT PLANTS

Moscow AGROKHIMIYA in Russian No 9, Sep 85 (manuscript received 25 Dec 84)  
pp 106-111

LOY, N.P., All-Union Scientific Research Institute of Chemical Means of  
Plant Protection, Moscow

[Abstract] In order to study the influence of rosaline (2-methyl-5-chlorobenzimidazole) on the Hill reaction, chloroplasts were extracted from the leaves of treated and controlled plants, 0, 24 and 48 hours after the plants were removed from a solution of the herbicide. The content of rosaline in the leaves was determined by TLC. The test plants, cotton, kidney beans, peas and wheat, reacted differently to rosaline, cotton being most resistant. Rosaline was an active inhibitor of the Hill reaction in experiments with isolated chloroplasts. Its ability to inhibit the Hill reaction indicates that its phytotoxic effect is probably based on its effect on photosynthesis. In experiments on isolated chloroplasts, no selectivity was observed. When the roots of the plants were treated, the difference in reaction of the sensitive and resistant plants depended on the quantity of the herbicide which reached the leaves. The effect of rosaline on the chloroplasts was found to be reversible. The activity of the chloroplasts was restored by washing. Figure 1; references 7: 4 Russian, 3 Western.  
[171-6508]

## EFFECTIVENESS OF SODIUM TRICHLOROACETATE AS FUNCTION OF ITS LOCATION IN SOIL

Moscow AGROKHIMIYA in Russian No 9, Sep 85 (manuscript received 17 Jan 85)  
pp 112-117

MARTYNOVITCH, N.N., Verkhnyachskaya Experimental Selection Station,  
Cherkassk Oblast

[Abstract] A model experiment was conducted to determine the influence of the depth of placement of sodium trichloroacetate in plowed soil. The test plant used was barley. Experiments were performed in metal containers, each with 13.5 kg of screened air-dry soil placed in the container in 5 cm layers and tamped after each layer to 1.1 kg/cm<sup>3</sup>. The experiments showed the importance of placing the herbicide at the seed level in the soil. Placement of the herbicide at lower levels did not cause complete death of the plants. The effectiveness of TCA also depends on the degree of mixing with the seed level of the soil. When placed as a screen at various depths in the seed layer, the toxicity varies. Maximum toxicity is achieved by good mixing in the seed layer. Figures 6, references 2 (Russian).  
[171-6508]

## LABORATORY CONTROL OF CHEMICALS IN AGRICULTURE

Moscow ZASHCHITA RASTENIY in Russian No 9, Sep 85, pp 6-8

PRIMAK, P.I., Agronomist, Administration of Plant Protection, Soyuzsel'kimiya Association

[Abstract] This article reports the achievements of toxicologists at the toxicologic monitoring laboratories responsible for testing of regulations for the application of pesticides and plant growth regulators as well as quality monitoring of the substances. It has been found that many pesticide manufacturers permit deviations from the State standards and technical conditions for their products. Specific examples of low active ingredient content in manufactured batches are cited. It is reported that pesticides stored for long periods of time lose large percentages of their active ingredients, so that even properly manufactured pesticides may be ineffective after long storage. The laboratories also test agricultural products for pesticide residues. In Khazakhstan, 259.7 thousand tons of products were analyzed in 698 farms to be sure the standards were met. Pesticide residues are generally found where agricultural workers do not follow instructions for use of pesticides. In the future, this aspect of the work of testing laboratories should be emphasized to continue protecting the population from pesticide and plant growth regulator residues.  
[147-6508]

## BIOLOGICAL METHODS OF PLANT PROTECTION IN BELORUSSIA

Moscow ZASHCHITA RASTENIY in Russian No 9, Sep 85 pp 3-5

SAMERSOV, V.F., director, Belorussian Scientific Research Institute of Plant Protection and SIDLYAREVICH, V.I., Chief, Department of Biological Methods

[Abstract] In Belorussia, the biological method of plant protection is used each year on some 100,000 hectares of fruit and vegetable crops; 40% of the total area. The study and practical application of antimonopathogenic microorganisms are leading to the development of a technology for effective application of existing commercial biological preparations, determination and selection of highly virulent and productive entomopathogens and the study of the nature of the effect of entomopathogenic microorganisms on both useful and harmful fauna in agrocenoses. The authors' Institute has developed a technology for the use of bitoxybacillin, dendrobacillin, lepidocide and entobacterin in integrated systems for the protection of fruit and vegetable crops as well as potatoes. Production testing is under way for a technology involving the use of bitoxybacillin against the Colorado Beetle. The technology of using biological preparations with large numbers of pathogens is being studied. A highly active strain of trichoderma has been isolated, allowing a significant reduction in cucumber root rot. The Institute plans to develop a technology for massive applications of new and effective entomophages and biological preparations and local application of small quantities of verticillin, ashersonia, trichodermin and boverin, which are not yet industrially produced. Optimal levels of insect populations, at which biological means are effective in field cultures, are being studied. [147-6508]

## PETROLEUM PROCESSING TECHNOLOGY

### TYUMEN OIL AND GAS EQUIPMENT SHORTAGES

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 5 Nov 85 p 1

[Report of All-Union meeting, Surgut, date not given, by correspondent Yu. Belanov and TASS correspondent V. Zhilyakov, Tyumen: "From a Position of General Interest"]

[Text] Strengthening the oil-energy base is the foundation of the main-line course of the party in the development of the Soviet economy. This is emphasized anew by the plan of the new editorial staff of the CPSU Program.

The conference of the party-economic aktiv of the Tyumen and Tomsk oblasts which was held in September defined a number of tasks, the resolution of which depends on the efficiency of our main oil and gas-producing rayon - Western Siberia.

Practical steps for putting into practice that which was outlined were examined in the recent past according to the initiative of the CPSU Central Committee and the USSR Soviet of Ministers at the All-Union meeting in Surgut in which leaders of many ministries, departments, central directorates, associations, scientific research institutes and planning institutes participated.

At the meeting, it was noticed that this year, delivery of machine-building production increased more than one and a half times.

But disturbing facts were brought out also. About 3,000 kilometers of rejected electrical cable accumulated at the Glavtyumenneftegas industries. At the same time, more than four hundred oil wells are standing idle because of shortages of it. About a million tons of oil were not delivered in August and September for this reason alone. For a long time, the Ministry of the Electrical Equipment Industry has not been able to repair the batch production of asynchronous and crane motors for machine churns and of automatic drilling keys with moisture and frost resistant insulators; the unreliable work of oil recovery rigs, pumps for maintenance of plastic pressure, and gas lift equipment produces justifiable grievances of the mine workers.

The volume of drilling work increases from year to year in subdivisions of central directorates. The 12th Five-Year Plan proposes to drill more oil field wells than in all the years of development of the stores of Siberian oil.

From this come the current tasks of scientists, designers and engineers, who are called upon to supply miners of deep mineral resources with a highly produc-

tive technique. However, drillings are as before and do not have reliable tam-  
ing engines. A new drilling rig, the Mintyazhmasha, upon which much hope was  
placed, proved to be cumbersome, possesses poor mountability, and is poorly  
adapted for use under conditions of the North.

Forty institutes of the country, of which 15 are branch and the remainder are  
academic and institutions of higher learning, help the Tyumen oil industry workers  
in creative trouble-shooting. Only in the past year has Glavtyumenneftegas  
transferred to them for studies according to different agreements, order-  
authorizations, and through the centralized fund of the ministry, about 40 mil-  
lion rubles. What is the return? After long arguments and calculations, the  
economic effect was determined to be the sum of 21.3 million rubles. For the  
last ten years, the collective of the Western Siberian Branch of the All-Union  
Petroleum Machinery Scientific Research Institute produced 116 inventions and  
obtained a number of patents and author's licenses for them. But the majority  
of these developments did not reach the oil fields. Only a handful of the 16  
developments of the branch which were recommended by the interdepartmental com-  
missions for series production made their way to plant shops.

According to the estimation of specialists, more than half of the almost two  
hundred fifty basic forms of equipment which are being supplied now by industry  
for Western Siberia do not conform to high requirements. This produces serious  
anxiety in oil and gas industry workers; indeed, in the forthcoming Five-Year  
Plan, the capital outlay of operating oil wells in Western Siberia will increase  
by a factor of two. Moreover, the proportion of a mechanized method of mining  
closely approaches the one hundred percent boundary.

As V. Dinkov, minister of the petroleum industry, stressed, the developed environ-  
ment requires the adoption of urgent measures for radical improvement of the  
technical level and reliability of oil field and drilling equipment.

Our branch, noted Minister of the Gas Industry V. Chernomyrdin, has made appro-  
priate conclusions from the work and miscalculations of oil industry workers.  
The course is taken for development of large-scale integrated-automated gas-  
producing enterprises, the building of which is conducted on the basis of block-  
unit equipment of high plant readiness.

The task of scale is not to be resolved without progressive and reliable engi-  
neering.

The development of the engineering of primary condensers does not tolerate delay.

The construction and installation work for the Samotlorsk gas lift compressor  
station was completed more than a year ago. But it is impossible to use it  
efficiently because of the poor quality of equipment manufactured at the  
Dzerzhinsk plant in Baku.

The Tyumen Oblast committee of the party and the collective of the petroleum  
central directorate are doing everything so that even before the end of the  
year, the country will obtain a million tons of raw material per day from the  
Tyumen oil fields. To reach this amount is possible, by not waiting until all

allied ministries and departments basically reorganize their work. There are resources which should be put in operation immediately. In fact, it must be confessed that oil field workers themselves occasionally break the rules for using oil-field equipment.

It is a word to the participants of the conference. G. Voronovskiy, minister of the electrical engineering industry said, "I consider the criticism correct; we shall rectify the situation. In particular, we shall promise to make the electrical cable which is of good quality and reliable. We shall considerably increase the life of deep-well pumps. We are working now on the development of a new electric motor for drilling and a more efficient feed unit for multiple drilling pump stations. Support points of engineering service are being developed at oil and gas centers.

V. Polyakov, minister of the automobile industry said, "Siberians are acutely needed in frost-resisting and all-terrain vehicles. And we not infrequently ship them to other regions. We, together with the leaders of the USSR Gosstab, promise to eliminate immediately the misalignments in supplying this technique. At all plants of the branch, we shall increase the ratings of the capacity of the vehicles for use in the north."

S. Afanasyev, minister of heavy and transport machine building said, "We have been asked urgently from this forum to fix the production of diesel engines for heavy-duty tractors. We shall fulfill this wish: we shall manufacture a hundred diesel engines in the very near future. I want to announce also that in the program developed by our specialists together with oil field workers, gas field workers and geologists-prospectors, an increase in the life of drilling installations to 7,500 hours is foreseen."

With understandable impatience, the participants of the conference awaited what the representatives of the Ministry of Chemical Machines were going to say. A year ago last summer, a business meeting took place in Baku at the initiative of the newspaper SOTSIALISTICHESKAYA INDUSTRIYA, at which the question, "What should be the technique for oil workers?" was discussed. In fact, almost half of the oil field equipment of Siberians was obtained from plants of the Soyuzneftemash All-Union Production Society.

What indeed has been changed in the last year and a half?

"The number of defects in several forms of equipment manufactured by Baku plants has even increased," noted L. Ovsy, chief mechanic of the Glavtyumenneftegaz. "Only in the last year and a half has the central directorate presented recommendations to the ministry for a sum greater than a million rubles."

Neither R. Ismaylov, chief of the association, nor V. Reznichenko, deputy of the Ministry of Chemical and Petroleum Machine Building, could answer this question. The initiative of the Ministry of Construction, Road and Municipal Machine Building was noted at the meeting. Without superfluous fine wire, the ministry arranged the firm's service with the spare parts of the oil and gas field workers. In connection with this, it was noted that it is not so complicated without great expenditures with the help of the ministries of the Tyumen enterprise to reorient for more effective assistance for oil and gas industry workers.

"Let us work together, shoulder to shoulder," said boring foreman P. Yevtushenko, when the participants of the meeting became acquainted with the team. "Give us reliable engineering, and we promise not to let you down!"

This is the opinion of those who, under difficult conditions, solve the national task of strengthening the fuel and energy bases of the country.

12410

CSO: 1841/196

## NEW WELLS ON YAMAL PENINSULA PRODUCE OIL AND GAS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Nov 85 p 1

[Article by A. Trutnev, Yamal Peninsula, under the "First Yamal Store" rubric: "Novoportovsk Oil and Gas Condensate Deposit Located on the Polar Circle on the Yamal Peninsula Yielded the First Tons of 'Black Gold'"]

[Text] Western Siberia does not have any equals in the extraction of oil and gas. The southernmost rayon of the Tyumen Oblast -- the Yamal Peninsula -- is designated as oil and gas bearing on geological maps. This region is severe: the long polar night, hard frosts with strong winds. In winter, you cannot even determine where dry land ends and the sea begins. However, nature was arranged so that precisely here, at the tops of the subterranean stratum of the Nurminsk arch, deposits of valuable carbonaceous raw materials are distributed -- Novoportovsk, Sredneyamalsk, Arktichesk, Bovankovsk, Kharasaveysk.;

The Novoportovsk deposit has been studied best of all. Eleven beds of sandstones containing gas, condensate and oil have been discovered in its depths. In individual wells, a flow up to 200 tons per day has been obtained. At the same time, the oil is of high quality and contains a large amount of light fractions.

The Ministry of the Gas Industry decided to begin scientific-practical experiments at the Novoportovsk deposit so that subsequently their results could be used in the development of other natural stores of Yamal. The fulfillment of this important task was entrusted to the veterans of the Tyumen North from the Nadymgazppom Industrial Association.

Today, Yamalsk is a completely modern working settlement, although it is not yet on geographic maps. Several well-organized hostels stand in a row, the construction of a sports complex has been completed, and a bakery, laundry, and a bath house are being built... Later on, motor vehicles will be transported from here for the shift of watchmen. But until there are roads, it is possible to reach the deposit only by all-terrain vehicle.

The necessary production subdivisions have already been formed and experimental-industrial work has unfolded at full speed. They include boring and investigation of wells, working out the technology of the extraction of oil, and getting it ready for transport. A recently created comprehensive expedition of the branch institute of the Ministry of the Gas Industry is in operation.



Teams of the Yamalneftegeologiya Association sink wells at Novoportovsk; the teams are headed by the well-known prospector of the northern depths, Lenin Prize laureate V. Podshibyakin. More than 200 wells of a depth up to three and a half kilometers have been drilled at the deposit. Geological explorers turned some of them over to experimental recovery. The team works very well under extreme subpolar experimental conditions in testing and developing wells under the leadership of V. Guseva, drilling helper F. Garifyanov, and machinists S. Mikov and Yu. Donets.

We set off with the chief geologist of the Novoportovsk management, V. Gontarenko, to well no. 169, where tests were going on. A bang of the flare gun--and an orange flame was noticed at the end of the outlet tube. "It burns by-product gas," explains Vladimir Ivanovich, "And here is where the gas condensate comes... Now there will be oil."

A cap of fire drooped for a second, but in the following instant, a flame again leaped up into the sky--higher and clearer than before. The flare blazed for several minutes, as if saluting the first shaft workers. Then the gate valve was switched, and the Yamal oil went to reservoir storage...

Bleak Yamal occupies a special position among oil and gas bearing rayons of Western Siberia: it is closest to the consumers in the European part of the country. The organization of industrial extraction of gas and oil on the peninsula serves as the beginning of the development here into the prospect of a new fuel-energy base.

12410

CSO: 1841/196

# TATAR OIL PRODUCTION ABOVE PLAN

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Nov 85 p 1

[Article by A. Mannanov, Tatar ASSR: Increased Output of Strata]

[Text] Industrialists of the largest scale oil and gas extracting administration in Tatarsiya. Sulevneft, reported the completion of the Five-Year tasks for extraction of fuel. The country obtained 25 million tons of liquid fuel. More than 500,000 tons of oil will be completely recovered from the deep mineral resources before the end of the year.

The collective works at high efficiency, obtaining more than 25 million rubles of above-plan profit. By extending the campaign for economy and prudence at all work places, the management workers since the beginning of the Five-Year Plan have economized more than 15 million kilowatt-hours of electrical energy and about 2,000 tons of different forms of fuel.

12410

CSO: 1841/196

## NATURAL GAS USED FOR TRUCK FUEL IN KAZAN

Moscow, SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 Nov p 1

[Article by correspondent U. Bogdalov, Kazan: "Natural Gas"]

[Text] A gas refueling station, which is the first in Tatariya, went into operation in Kazan. Two hundred automobiles of the Tatavtotrans Association are "charged" here.

A new gasification step has come into the life of motorists of the republic. For several years a small group of trucks operated on a liquefied gas "cocktail" containing propane and butane—a valuable raw material for petrochemistry. Now they refuel with inexpensive natural gas, which basically consists of methane.

The low price is not the only advantage. The life of the trucks working on gas is increased by 50,000 kilometers. The exhaust becomes three to four times cleaner. One tankful is enough for 250 kilometers, only enough to go from Kazan to Brezhnev, for example. Therefore, "gas trucks" will be used for the first times in Kazan.

12410

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UDC 622.245.73

UNIVERSAL [BLOWOUT] PREVENTORS FOR PETROLEUM AND GAS FIELDS WITH HIGH  $H_2S$  AND  $CO_2$  CONTENT

Moscow KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian No 10, Oct 85  
pp 4-5

KURBANOV, N.G., engineer, FRENKEL, B.O., candidate of technical sciences,  
POTAPOV, V.S. and BARKHUDAROV, N.M., engineers

[Abstract] Two universal preventors were jointly developed by the Azerbaydzhani Scientific Research Institute of Petroleum Machine Building and the Machine Building Plant imeni Lieutenant Shmidt. They were designed to prevent discharges and runaway wells during drilling and repair operations in oil and gas fields with up to 6% each  $H_2S$  and  $CO_2$ . These preventors -- PU1-350X35K2 with a 350 mm aperture and PU1-180X35K2 with a 180 mm aperture -- consist of a cap, a plunger, a bushing and a massive rubber packing ring with metal inserts. These components form two hydraulic chambers arranged so that the entry of pressurized oil forces the packing toward the center and will seal any portion of the drilling column. It can also cap the well if there is no pipe column in it. A test samples of the PU1-180X35K2 operated satisfactorily for 3500 hours in an  $H_2S$  environment under 35 MPa pressure. Figures 1.  
[208-12672]

## POLYMERS AND POLYMERIZATION

### POLYMER REPLACEMENT FOR LEAD IN BATTERIES

Moscow ZNANIYE-SILA in Russian No 10, 1985 p 10

[Article by A. Fin: "A New Type of Battery: Polymer Instead of Lead"]

[Text] An important trend in the conservation of metal is the substitution of advanced non-metallic materials such as ceramics, plastics, glass, and reinforced concrete for metals.

Can electrical energy be stored? The question might seem flipant: it's been half a century since lead, cadmium-nickel, and iron-nickel accumulator-type batteries expressly designed for this purpose have been developed. But has the problem of storing electrical energy been solved? The simplest way to find out would be to ask automobile enthusiasts. They would tell you "no". Batteries cannot survive a depleted charge, and they only last three years at most. Their weight makes one wish there was something better. The electrolyte is acid. One more point can be made here: the earth's supplies of lead are far from unlimited.

What would the ideal battery be like? It's not hard to think of requirements. It should have unlimited electromotive force, unlimited capacity, be practically weightless, and last forever. Of course, these qualities will never be a reality. That is why researchers are primarily trying to reduce battery weight or, in other words, to increase the specific power capacity through weight reduction. The easiest way to achieve this is to use light-weight metals such as lithium. However, electrodes made of lithium wear out rather quickly. For this reason, researchers are experimenting with lithium alloys and other metals. All the same, no one has great hopes that a serious competitor to the lead battery will emerge. Truth to tell, there never were. In the department of corrosion and metal electrochemistry headed by Professor Ya. M. Kolotyarkin and part of the L. Ya. Karpov Institute of Chemistry and Physics, the problems of electrical energy accumulation have not been studied. The department's mission is basic research for the chemical industry and is in no way associated with the production of batteries. Just the same, the department has come in contact with the problems of battery manufacturing.

One reason for this was the synthesis of unusual organic polymers capable of conducting electrical current even though they contain no graphite or carbon, the materials usually used to endow plastics with conductivity. The secret of the electrical conductivity of the new materials lies in the high

mobility of the electrons in polymer molecules. Moreover, during alloying, the system takes on a new energy state with a conductivity close to that of metal.

Researchers are primarily interested in polypyrroles. Polypyrroles are a colorless liquid found in coal tar. It boils at 130 degrees C and dissolves poorly in water. In comparison with acetylene, which, after polymerization (during which polyacetylene is obtained) and alloying, also can conduct electricity, pyrrole is not as available and is more expensive. On the other hand, in contrast to acetylene, it is many times cheaper to polymerize. Instead of complex catalyzing systems vulnerable to moisture and oxygen, researchers used an electrochemical cell, i.e., simply put, a glass vessel holding an electrolyte containing pyrrole, and instruments for passing current through the cell.

The electric current causes the pyrrole to polymerize and form a polypyrrole film on one of the electrodes of the cell. It is also simple to improve the electric properties with the help of the electric current by incorporating the correct admixtures into the film as it forms.

The result of synthesizing polypyrrole, which was expected by scientists, has promised to be significant. Experts are well aware that the production of persulphates, as they are called, which are strong oxidizers for a number of chemical processes, is relatively expensive. During production (persulphates are obtained electrochemically), the electrodes wear out fairly quickly. It was thought that the newly synthesized material could be used to increase the life of the electrodes.

By measuring the potentials of the electrodes as current is passed through them, scientists can tell a great deal about the materials from which they are made. However, with the polypyrroles, the unexpected occurred from the beginning. Polypyrroles synthesized on platinum behaved just like, well... platinum. It is an organic polymer that behaves like metal. Why? Do these properties belong to the polymer itself, or is the structure porous, and do the ions from the solution, bypassing the polypyrrole molecules, go straight to the electrode itself?

A precise answer could only be found after polypyrrole was synthesized on the surface of an electrode made of titanium and a chemical reaction, which usually does not occur on titanium, was conducted on the electrode. This means that the electrical conductivity of polypyrrole is, in reality, excellent and approximates the electrical conductivity of metal.

The research, in addition to the electrical conductivity and many other properties of polypyrrole, yielded data about its ability to store electrical energy.

In principle, any conductor can be utilized to accumulate an electrical charge. An example of this is an ordinary capacitor. The bigger the area of its capacitor plates, the bigger its capacity. Of course, however, the capacity of any capacitor is ridiculously small in comparison with the amount of energy

stored in a battery. The reason for this is that a battery stores electrical energy, converting it into energy from a chemical reaction; in other words, it uses electrical energy to synthesize new chemical compounds.

As it turns out, polypyrroles can do the same thing!

To be sure, further research encountered all kinds of complications. In the first place, polypyrroles obtained in different experiments possessed different electrical properties.

Why did polypyrrole turn out differently each time? It was difficult to blame it on instrument error—the instruments are carefully calibrated before each experiment. Each time, the electrochemical cell was the same. Perhaps chemical impurities on the surface of the electrodes on which the polymer was synthesized were to blame? Prior to synthesis, these surfaces are usually burned with acid and peroxide, rinsed with water, and the prepared electrodes are quickly transferred to the solution, where the synthesis is actually performed. The only thing left to assume was that admixtures contained in the pyrrole itself were the source of the problem.

Pyrroles were studied with ultraviolet spectrometers and nuclear magnetic resonance, and other methods with equally complicated names were used. It was established that pyrrole actually is chemically impure. Attempts to fully determine the composition of the admixtures were unsuccessful, and a technique for purifying the polymer had to be found experimentally.

Having solved one problem, scientists stumbled onto another. Researchers discovered that polypyrroles, which are elastic and stable in an electrolyte, become brittle when exposed to air and start to come off the backing on which they were synthesized. This renders them useless. A "hole" in a polymer has the same effect as porosity, and the result will be that the backing will be doing the job instead of the polymer.

It would seem at first glance that this drawback was dealt with in an unorthodox fashion. The polypyrrole was precipitated onto a thin film of polyvinyl chloride. Polyvinyl chloride is used as an insulator in electric cable. However, polyvinylchloride can be only arbitrarily called an insulator: it is porous, and in a solution, it does little to prevent ions from penetrating to the surface of the conductive film. There were—and are—other problems. It has already been shown, though, that the number of charging cycles is virtually unlimited by polypyrroles.

This means that batteries of polypyrrole will be unusually durable. Electrodes made from the new plastic will be able to function effectively in a saline electrolyte. To put it simply, they will even be able to work in sea water.

The weight of polypyrrole batteries cannot be compared with the weight of lead batteries. An exciting future is in store for the practical applications of electrical engineering. The new batteries are paving the way for the development of a "clean automobile."

For the time being, it is difficult to say exactly when these new batteries will be suitable for industrial use. However, scientists think that it is not a distant future thing.

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13050/9716

CSO: 1841/108



UDC: 677.529:546.13

INTERACTION OF CARBON FIBERS OF VARIOUS TYPES WITH CHLORINE

Moscow KHIMIYA TVERDOGO TOPLIVA in Russian No 5, Sep-Oct 85 (manuscript received 9 Apr 84) pp 135-138

IVIN, V.D., MALKOV, A.A., LEVIT, R.M. and SMIRNOV, Ye. P., Leningrad Branch, All-Union Scientific Research and Planning Institute of Artificial Fiber

[Abstract] Chlorination was used to study the chemical nature of the surface of carbon fibers and produce carbon fibers with chemically homogeneous monofunctional surfaces. Studies were performed on fibers obtained by carbonization of hydrate cellulose, polyacrylonitrile and polyvinyl alcohol fibers at up to 900 °C, following treatment of the specimens at 900 °C, in highpurity argon to eliminate most of the surface functional groups. Chlorination of the carbon fiber surfaces revealed significant differences in the chemical nature of their surfaces as a function of the type of initial raw material. It was shown that chemisorption of chlorine with subsequent thermogravimetric analysis of products can be used as a method of determining the structural specifics of carbon fibers. Figures 4; references 6 (Russian).  
[174-6508]

UDC 678.742.2.046:669.14:539.61

KINETICS OF ADHESIVE INTERACTION OF POLYOLEFINS AND METAL IN CONTACT THERMOOXIDATION. PART 6. EFFECTS OF ADSORBENT FILLERS ON ADHESIVE INTERACTIONS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA in Russian No 5, Sep-Oct 85 (manuscript received 11 Apr 85) pp 575-581

KALNIN, M.M. and MALERS, L.Ya., Riga Polytechnic Institute imeni A.Ya. Pelshe

[Abstract] An analysis was conducted on the kinetics of adhesive interactions between low-density polyethylene and steel to determine the effects of various inorganic adsorbent fillers (metals, metal oxides, activated carbon, talc). Under conditions of contact thermooxidative destruction of

the polymer, the adhesive properties of a given filler were basically predicated on the ability of the filler to adsorb the low MW products of polyethylene destruction. Adsorption of the destruction products to the filler leads to a concentration gradient of the decomposition products within the polymer, particularly at the polymer-metal interface as a result of diffusion of the decomposition products from the contact surface. The decrease in the concentration of the destruction products at the interface increases the cohesiveness at the polymer-metal interface. Figures 3; references 12: 11 Russian, 1 Western.  
[251-12172]

UDC 620.179.4:678.742.2.046:669.14

KINETICS OF ADHESIVE INTERACTION OF POLYOLEFINS AND METAL IN CONTACT THERMO-OXIDATION. PART 7. KINETIC DESCRIPTION OF RESISTANCE TO PEEL-OFF OF ADHESIVE FILLED-POLYETHYLENE-STEEL LAMINATES

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA in Russian No 5, Sep-Oct 85 (manuscript received 11 Apr 85) pp 582-587

KALNIN, M.M. and MALERS, L.Ya., Riga Polytechnic Institute imeni A. Ya. Pelshe

[Abstract] A kinetic study was conducted of the effects of fillers on peel-off of low-density polyethylene laminated on steel in contact thermooxidation. The fillers functioned as adsorptive agents for low MW products resulting from thermal decomposition of polyethylene, diminishing the concentration of the products at the superficial polymer layers and thereby contributing to increased cohesiveness at the polymer-steel interface. On balance, resistance to peel-off was counteracted by oxidative crosslinking in the polymer. Analysis of the temporal contribution of both factors--thermooxidative destruction and crosslinking--demonstrated that an increase in the concentration of adsorptive fillers leads to an increase in maximum attainable resistance to peel-off and to the time required for maximal resistance. Increasing the temperature of contact oxidation serves to decrease the  $t_{max}$ . Figures 4; references 3 (Russian).  
[251-12172]

.UDC: 541 (64+126)

INFLUENCE OF COMPOSITION OF REINFORCING CHEMICAL FIBERS ON DESTRUCTION  
AND FIRE-PROOFING OF COMPOSITE MATERIALS

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85  
(manuscript received 14 Feb 84) pp 2035-2039

PANOVA, L.G., ARTENENKO, S. Ye., KHALTURINSKIY, N.A. and BERLIN, Al. Al.,  
Saratov Polytechnic Institute

[Abstract] The use of chemical fibers containing antipyrene to reinforce synthetic resins is a new method for decreasing the flammability of composites. In this work a composite of phenol-formaldehyde and epoxy resins containing polyethylene polyamine was used. Combustion was studied on an installation allowing simultaneous recording of continuous changes in weight of the specimen during pyrolysis and combustion, the temperature in the surface layer of the polymer specimen and in the flame and the period of induction before ignition. It was determined that the temperature in the surface layer of the epoxy composite material is related to the chemical nature of the reinforcing fiber. Polyacrylonitrile fibers are most resistant to heating and have the greatest surface temperature and least weight loss. PAN fibers increased the flame temperature of both phenol and epoxy composites by 20-30°C, whereas chlorine-containing PAN fibers reduce the flame temperature below that of the unreinforced resin. Figures 3, references 8: 6 Russian, 2 Western.  
[178-6508]

UDC: 541(14+64)547.572.1

INFLUENCE OF STRUCTURE OF BENZOPHENONE DERIVATIVES ON EFFECTIVENESS OF  
PHOTOINITIATED CROSS LINKING OF POLYETHYLENE

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85  
(manuscript received 22 Feb 84) pp 2072-2078

ZAMOTAYEV, P.V., GRANCHAK, V.M., LITSOV, N.I. and KACHAN, A.A., Department  
of Petrochemistry, Institute of Physical Organic Chemistry and Carbon Chemistry,  
Ukrainian SSR Academy of Sciences

[Abstract] The purpose of this work was to establish the relationship between the quantum yield of cross linking of polyethylene and the chemical structure of the photoinitiator. Benzophenone and a number of its derivatives were studied, since it is among the most widely used photoinitiators for the formation of macroradicals in high molecular weight compound chemistry. The initiating capacity of benzophenone derivatives is found to correlate with the quantum yield of their photoreduction, decreasing with a decrease in diffusion factor, and varying as a function of donor-acceptor properties of the substituent. Introduction of a substituent on the benzophenone molecule does not increase its effectiveness in the process of photoinitiated cross

linking of polyethylene but can delay loss of initiator by the film. The studies performed show that the low radical pair breakdown yield upon photo-reduction of ketone should be observed in benzophenone derivatives with volumetric substitutions at positions 3 and 4, which are effective photo-reducers but have low mobility in the polymer. Figures 3; references 19: 5 Russian, 14 Western.  
[178-6508]

UDC: 541.64:539.3

#### INFLUENCE OF AEROSIL SURFACE ON ENERGETIC INTERACTION WITH PVC AND MECHANICAL PROPERTIES

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85  
(manuscript received 4 Mar 84) pp 2109-2112

YUSHKOVA, S.M., GUZEYEV, V.V., TAGER, A.A. and MARTYNOVA, L.M., Ural State University imeni A.M. Gorkiy; Scientific Research Institute of Chemistry and Technology of Polymers imeni V.A. Kargin

[Abstract] Thermodynamic parameters of the interaction of polyvinyl chloride are determined with aerosils having different types of surfaces, and compared with the mechanical properties of the resulting composites. Modified aerosils were found to have poorer energetic interaction with PVC plasticized with dioctyl sebacinate than nonmodified aerosil. As the interaction of PVC with the filler surface increases, the rigidity (elasticity modulus) of the specimens increases, correlating with an increase in thickness of boundary layers to 3-5 nm. The stress relaxation rate after the interface arising upon deformation of specimens decreases. Access stress at the interface facilitates delamination of the polymer from the surface of the filler. Figure 1, references 12 (Russian).  
[178-6508]

UDC: 541(64+127):547(256.2+313.2)

#### INFLUENCE OF VARIOUS FACTORS ON KINETICS OF CONSUMPTION OF ETHYLENE IN POLYMERIZATION ON THE SURFACE OF KAOLIN PARTICLES TREATED WITH ORGANO-ALUMINUM COMPOUNDS

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85  
(manuscript received 6 Mar 84) pp 2120-2124

VLASOVA, N.N., MATKOVSKIY, P.Ye., YENIKOLOPYAN, N.E., POPOYAN, A.T., VOSTORGOV, B.Ye. and SERGEYEV, V.I., Institute of Chemical Physics, USSR Academy of Sciences

[Abstract] A study was made of the influence of various factors on the kinetics of consumption of ethylene in polymerization on the surface of

particles of kaolin treated with organoaluminum compounds, and on the properties of the polyethylene-kaolin composites produced. Kaolin with specific surface 24 and 20 m<sup>2</sup>/g were used, containing  $0.4 \pm 0.01$  wt.% titanium,  $0.11 \pm 0.03$  wt.% vanadium and  $0.02 \pm 0.01$  wt.% chromium. A sharp increase was observed in the initial polymerization rate of the ethylene when the temperature at which the kaolin was dried was increased from 273 to 873 K, which cannot be explained by development of kaolin surface during drying. It is the removal of water in the process of deep drying of kaolin which is the necessary prerequisite for the formation of active polymerization centers. The catalytic activity of kaolin treated with organoaluminum compounds is determined by the compounds of titanium, vanadium and chromium present in the kaolin. The initial rate of polymerization and eventual yield of polymer increased linearly with increasing quantity of kaolin added to the reactor. Polymerization is localized on the surface of the kaolin particles, though determination of the nature of the active polymerization centers will require additional experimentation. Figures 6, references 8: 7 Russian, 1 Western.  
[178-6508]

UDC: 541(15-64)

SPECIFICS OF ELEMENTARY STAGES OF RADIATION POLYMERIZATION OF MONOMERS ON THE SURFACE OF SOLIDS. RADICAL POLYMERIZATION IN SYSTEMS WITH WEAK ADSORPTION BONDS

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85 (manuscript received 12 Mar 84) pp 2143-2149

BRUK, M.A., PAVLOV, S.A., ISAYEVA, G.G. and YUNITSKAYA, Ye.Ya., Scientific Research Physical-Chemical Institute imeni L.Ya. Karpov

[Abstract] A study was made of the mechanism of the elementary stages of polymerization in systems with weak adsorption bonds. Systems with weak bonds, radiation polymerization in which occurs primarily by radical mechanisms, include vinyl acetate, methyl methacrylate, n-butyl methacrylate, methyl acrylate, adsorbed on A-175 aerosil treated in a vacuum at various temperatures. The process of polymerization is generally described, and specifics of elementary stages are noted. The elementary stages include chain initiation, chain growth, chain transfer to monomer and breaking of kinetic chains. Although the specifics of the initiation described are characteristic only for polymerization under the influence of ionizing radiation, the basic specifics of the other elementary reactions are characteristic for radical polymerization on surfaces with other methods of initiation as well. References 16: 14 Russian, 2 Western.  
[178-6508]

## ELECTROCHEMICAL REDUCTIONAL DESTRUCTION OF SOME CARBOCHAIN POLYMERS

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85  
(manuscript received 12 Mar 84) pp 2161-2164

SHAPOVAL, G.S., PUD, A.A., ZAMOTAYEV, P.V. and KACHAN, A.A., Department of Petrochemistry, Institute of Physical-Organic Chemistry and Coal Chemistry, Ukrainian SSR Academy of Sciences

[Abstract] The purpose of this work was to study the specifics of electrochemical reductional destruction (ECD) of certain carbochain polymers and the influence on this process of side groups of the macromolecules differing in electron-acceptor activity. Polyethylene, a copolymer of ethylene with vinyl acetate, and polytetrafluorethylene, used as protective coatings on metals, were studied. The resistance of the polymers to ECD decreases in the sequence PE  $\gg$  ethylene-vinyl acetate copolymer  $>$  PTFE. The sequence in resistance of carbochain macromolecules to electrochemical reduction is explained by the fact that polymerization of the CR bond, conjugate with the  $-C=C-$  double bond of the main chain is so great where R is an ester group or halide atom that electron transfer causing subsequent chemical conversion becomes quite possible and occurs at low potentials. Figure 1, references 13: 12 Russian, 1 Western.

[178-6508]

## PHOTOINITIATION IN LONG-WAVE PHOTOOXIDATION OF POLYAMIDES

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85  
(manuscript received 16 Mar 84) pp 2175-2183

POSTNIKOV, L.M., VICHUTINSKAYA, Ye.V. and LUKOMSKAYA, I.S., Institute of Chemical Physics, USSR Academy of Sciences

[Abstract] The process of photooxidative destruction of aliphatic polyamides occurring in sunlight can be modelled by artificial irradiation with light in the 365-436 nm wavelength range. Under these conditions, a constant rate of absorption of oxygen is quickly achieved, proportional to the square root of light intensity, identical for various polyamides regardless of prehistory. A mechanism of the process is suggested including photoinitiation of radical chains by an oxidation intermediate product. Mobile low-molecular weight radicals are assumed to play an important role in the process. Figures 7; references 14: 9 Russian, 5 Western.

[178-6508]

UDC 677.051.277:65.011.56.

AUTOMATED CONTROL AND MAINTENANCE OF MOLDING AND WINDING MACHINES

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 pp 10-11

KLYUCHNIKOV, V.V., DUMCHENKO, Yu.V. and MASLOV, A.D.

[Abstract] A systems approach is described to the automation of molding or extrusion and winding machines for use in polyamide fiber production. The basic questions that are considered in broad generalities deal with process control, automation of manual operations, and control of product flow. The basic objectives are to assure minimal disruptions caused by fiber breakage. Technical feasibility studies for such systems are to be commenced in 1985, and the system is to be applied to other similar processes. Figures 3.  
[186-12172]

UDC 677.494:678.01-19

PRODUCTION OF ULTRATHIN FIBERS FROM POLYMER MIXTURES

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 4 Aug 85) pp 12-15

SHITOV, N.A., TIMOFEYEVA, G.I. and AYZENSHTEYN, E.M.

[Abstract] A review is presented of technical approaches to the production of ultrathin fibers from polymer mixtures. Basically, two types of extrusion processes can be employed to produce 'fibrils in matrix' and 'islands in sea' type composites. The latter differing from the former in that the fibril polymer has a defined distribution in the matrix polymer. The former fibers are produced by the usual extrusion process of a mixture of two incompatible polymers, whereas the latter product requires a special spinnerette with separate inflow of the two polymer melts. Such ultrathin fibers can be used for the production of second generation synthetic leather, once a number of technical and engineering problems dealing with viscoelastic and tensile characteristics of the ultrathin fibers are solved. Figures 6; references 28: 10 Russian, 18 Western.  
[186-12172]

POLYMERIZATION OF TETRAHYDROFURAN INITIATED BY ACETIC ANHYDRIDE AND  $\text{SbCl}_5$ 

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 2 Jan 85) pp 24-26

IVANOVA, S.A., SAMSONOVA, T.I., MIKHAYLOVA, G.D. and CHEGOLYA, A.S.

[Abstract] An analysis was conducted on the efficiency of a mixture of acetic anhydride and  $\text{SbCl}_5$  as an initiator for the polymerization of tetrahydrofuran into (polytetramethyleneoxide) diacetate. Monitoring of the product MW and polymerization kinetics over a temperature range of 0-40°C demonstrated that the rate and polymer yield were directly proportional to the concentration of the initiator. The MW of the polymer was inversely proportional to the temperature, due to an increase in the rate of depolymerization with an increase in the temperature. With  $\text{SbCl}_5$  polymers with MW of 1000-3000 daltons were obtained at higher temperatures than with initiator systems employing  $\text{HClO}_4$ , and yet the concentration of the initiator was an order of magnitude smaller than in the latter system. In addition, the  $\text{SbCl}_5$ -based initiator system made possible removal of unreacted tetrahydrofuran and acetic anhydride from the product by simple distillation. Figures 3; references 7: 3 Russian, 4 Western: [186-12172]

UDC 621.7.044:494.674

## HIGH-SPEED FORMATION OF POLYESTER FIBERS

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 19 Feb 85) pp 27-28

GELLER, V.E. and AVERKIYEV, B.N.

[Abstract] An evaluation was conducted on the physicomachanical characteristics of high-speed formation of polyethylene terephthalate fibers. For the formation of 7, 15 and 15 tex fibers, use was made of spinnerets designed for 3000 and 4500 m/min rates. Tabular data are provided on the deformation characteristics and orientation, correlating longitudinal velocity gradient and extension zones (deformations) with linear densities. The data showed that with a decrease in the linear densities from 25 to 7 tex the longitudinal velocity gradient increased markedly from 55 to 77  $\text{sec}^{-1}$  at 3000 m/min, and from 74 to 187  $\text{sec}^{-1}$  at 4500 m/min. Determinations of changes in streaming birefringence showed a decrease in this parameter for 15 and 25 tex fibers as they were extruded from the lubricating capillary, but an increase in the case of the 7 tex fibers. This difference was attributed to the greater rate of cooling of the 7 tex fibers, and its greater longitudinal velocity gradient to air friction. Figures 1; references 5: 1 Russian, 4 Western. [186-12172]



# PERFORMANCE CHARACTERISTICS OF POLYPROPYLENE FIBERS PREPARED WITH MIXTURES OF SOVIET NONTOXIC STABILIZERS

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 17 Jan 85) pp 38-39

YEFIMOV, A.A., KOLOMYTSYN, V.P., IVANENKO, P.F., KRYMOV, A.V., SVETLITSKIY, Yu.A., TEMCHENKO, L.I., NIKIFOROV, Yu.N. and ZVEREV, M.P.

[Abstract] Trials were conducted on the processing and performance characteristics of polypropylene fibers prepared with the use of a variety of Soviet, nontoxic, stabilizers. Analysis of the chemical and physical characteristics demonstrated that mixtures of stabilizers in concentrations of 0.1-0.3 wt% yielded products meeting sanitary and fabricating standards. Thus, Soviet stabilizers benzon OA, fenozan 23 and fosfit NF [sic] can be used to replace tinuvin 327 [sic], as well as to reduce two-fold the concentration of the costly irganoks 1010 [sic] in the polymer. Polypropylene products stabilized with the Soviet reagents are suitable for food contact and, when used according to the prescribed formulation, should reduce the cost of the polymer by 22.5 rubles per ton. Figures 1; references 2 (Russian).

[186-12172]

# EFFECTS OF SPINNING ON NICKEL-TREATED NITRON FIBERS

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 6 Feb 85) pp 39-40

AKBAROV, D.N., OVCHINNIKOVA, T.N. and SAMOYLOVA, L.A.

[Abstract] An analysis was conducted on the effects of carding and goffering of Nitron (polyacrylonitrile) fibers chemically treated with Ni on the Ni levels of the fibers and the electrical characteristics. Goffering resulted in marked deterioration of the mechanical characteristics of the fibers, as well as in a marked (8-fold) increase in electrical resistance. The changes were apparently due to alterations in the metal coating and metal-polymer adhesion, leading to loss of the metal. The latter led to diminished conductivity and weakening of the fiber. Further fiber processing did not lead to any further loss of Ni, but was accompanied by a continuing increase in electrical resistance. Maximal resistance was reached after a second carding, with no further increase thereafter. This phenomenon was ascribed to maximal disruption of contact among the elementary fibrils, leading to fibers homogeneous in electrical conductivity. In order to maintain electrical conductivity characteristics of nickel-treated Nitron fibers, spinning should be conducted under conditions designed to avoid goffering. References 3 (Russian).

[186-12172]

IMPROVEMENTS IN HEATING MACHINES FOR CHEMICAL FIBER BANDS

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 2 Apr 85) pp 49-51

KOROVITSYN, O.G., FOROST, V.I., FOMENKO, L.N. and KUNIN, I.Z.

[Abstract] An energy-efficient heating machine was designed for chemical fiber bands for thermal drawing out and fixation of bands with linear densities approaching 144 ktex. The apparatus consisted of two coaxial cylinders isolated from one another and supplied with low potential (8 V) current. The distinguishing feature of the present model was an oval working channel. Data comparing dimensions and energy requirements for this and conventional models are presented in tabular form, with performance depicted in graphic form. The improvements introduced into the new apparatus resulted in a 1.4-fold reduction in energy requirement for thermal fixation. Figures 4; references 2 (Russian).  
[186-12172]

UDC 620.193.4:66.023-034.14[sic]; 678.742.3.002.2

CORROSION RESISTANCE OF CONSTRUCTION MATERIALS IN WORKING ENVIRONMENT OF POLYPROPYLENE PRODUCTION

Moscow KHIMICHESKOYE I NEFTYANOYE MASHINOSTROYENIYE in Russian No 10, Oct 85 pp 21-22

VERICHEVA, L.A., DEMIDOVA, L.V., DUMOV, B.I. and ZHILTSOV, N.P., engineers

[Abstract] Corrosion has been observed in imported polypropylene production equipment constructed from carbon steel, enameled steel, and corrosion-resistant 08Kh18N10T and 03Kh17N13M2 steels. This was attributed to hydrogen chloride and NaCl formed from the breakdown of  $TiCl_3$  and diethyl aluminum chloride catalysts. In order to determine optimum material design, the Leningrad Scientific Research Institute of Chemical Machine Building carried out tests of steels and alloys in a working environment of polypropylene production. Samples were prepared from rolled sheet without any supplementary heat treatment in accordance with RTM 26-01-121-68, "Methods of Corrosion Testing of Metallic Materials. Basic Requirements. Evaluation of Results." The type of corrosion was determined visually and with the aid of a magnifying glass (7X) and an MBS-1 microscope. Results showed most of the metal samples were subject to corrosion from the chlorine-containing compounds in the working environment of the sections of the equipment for degassing, decomposition of the catalyst and washing of the polymer. The depth of corrosion of samples in the vapor phase of the separating chamber for primary extraction of the water phase was 0.01-0.32 mm, but not over 0.07 mm in other parts of the equipment. A detailed table of results shows that

alloy KhN65MB and titanium VT1-0 were most resistant. Nickel steels 08Kh22N6T and 08Kh18G8N2T used in the section for catalyst preparation showed a corrosion rate under 0.01 mm/yr, so they could be substituted for 12Kh18N10T in this application  
[208-12672]

#### MECHANISM OF LASER CRACKS ORIENTATION IN TRANSPARENT POLYMERS

Leningrad ZHURNAL TEKHNIЧЕСКОY FIZIKI in Russian Vol 55, No 4, Apr 85  
(manuscript received 17 Jun 84) pp 778-781

KONDRATOV, S.V., POLIPETSKIY, N.F., SAVANIN, S.Yu. and SHKUNOV, V.V.,  
Institute of Mechanics Problems, USSR Academy of Sciences, Moscow

[Abstract] Formation of laser cracks and their orientation was studied in polymethylmethacrylate exposed to Nd laser pulse radiation with pulse duration  $10^{-3}$  s, input  $\varphi \sim 10^{-2}$  rad, energy 1-5 J. Experimentally the number of cracks with diameter  $\geq 3$  mm was determined as a function of the incident angle of nonpolarized radiation. At the angle  $\theta = 40-55^\circ$  a maximum was observed and the curve dropped to 0 at  $\theta \geq 55^\circ$ . The reason for this must be in the light energy introduced per unit area of the developing crack. It was concluded that in case of flat polarization of the radiation, orientation of the cracks becomes very "rigid" and the normal line towards the crack tended in the direction of the polarization plane of the incident jet. Figures 2; references 5 (Russian).  
[226-7813]

NEW RADIUM DETECTOR

Moscow KHIMIYA I ZHIZN in Russian No 6, June 85 pp 34-35

{Article: "New Method for Radium Detection"}

{Text} The classical method for detecting radium in rock and ores as proposed at the beginning of the present century by Marie Curie is rather complicated. The test sample is first dissolved, then the radium is precipitated out of the solution. Then the gaseous products of radioactive decay (emanations) that accumulate in the precipitate are transferred to special chambers in which the concentration of the emanations are measured radiometrically, i.e., by the intensity of emitted  $\alpha$ -irradiation. The disadvantages of the radiochemical analytical method are related to that method's considerable labor-intensity and consumption of time. Moreover, assay errors can occur not only as a result of radiometric mistakes, but also because of the incomplete chemical separation of the isotopes from the solution. The new method for detecting radium isotopes that was worked out at the All-Union Scientific-Research Institute of Mineral Resources, does not require the preliminary chemical preparation of the test samples because that method is based on selection of time emissions of nuclear irradiation.

As is known, there are in the uranium and thorium series short-lived pairs of radionuclides:  $^{214}\text{Bi}-\beta \rightarrow ^{214}\text{Po}$  with a daughter radionuclide half-life of about 160 microseconds and  $^{212}\text{Bi}-\beta \rightarrow ^{212}\text{Po}$  with a daughter radionuclide half-life of about 0.3 microseconds. If one records the mother and daughter particles emitted by a probe at a specific chronometric interval, it then becomes possible to detect the radiation from the given pair of radionuclides. One can then estimate, for example, the amount of equilibrant  $^{226}\text{Ra}$  in the test sample from the intensity of radiation.

But how does one detect and seize a genetically bound pair of  $\beta$  and  $\alpha$  particles? If one knows the half-life periods, this can be done quite simply. The  $\alpha$ -particles emitted by the sample must be recorded within 600 microseconds after recording each  $\beta$ -particle. In this way one can account for about 90 percent of the  $^{214}\text{Po}$  decay. Inasmuch as the half-life period of a daughter radionuclide in thorium is considerably less, so too is the chronometric interval after recording the first  $\beta$ -particle. That interval is 1.5 - 2 mcseconds for thorium. If the test sample contains radium and thorium, the effect of decays in the thorium series on the radium assay is

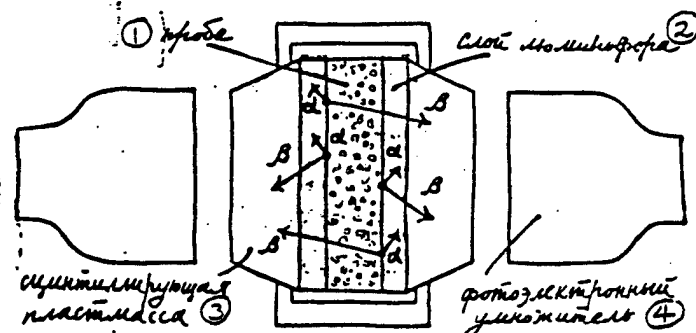
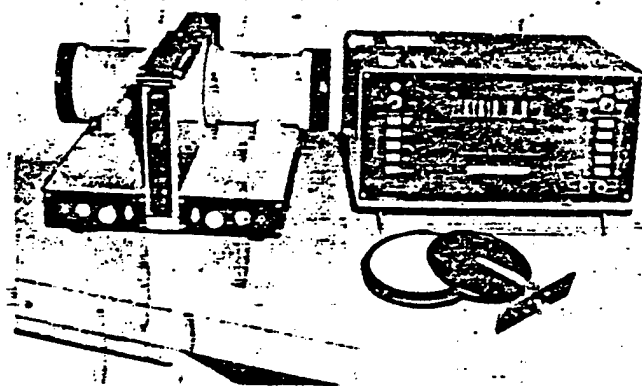
easy to eliminate. In order to accomplish this, one does not count the  $\alpha$ -particles for the first three microseconds (tenths of  $^{212}\text{Po}$  radionuclide half-life) after recording the starter  $\beta$ -particle.

Such is the principle of assay employed here. The Nuklon instrument which was designed to detect radium in powder samples functions in the following manner: The particles enter a scintillation scanner with a combination two-layered detector. The  $\alpha$ -particles are absorbed in the fine layer of the luminophore ( $\text{ZnS}$ ), and the  $\beta$ -particles permeate this layer and enter the next layer which constitutes a scintillating plastic. Inasmuch as the duration of scintillations in each of the luminophores is different, one can easily distinguish between the  $\alpha$ - and  $\beta$ -particle impulses at the outlet of the photoelectron amplifier. The instrument's electronic circuit works in the following way: A  $\beta$ -particle impulse opens up a window of the acceptor cell for the necessary period of time, and the  $\alpha$ -particle that arrives in this interval is fixed by a recording device.

And what about the background particles that are emitted by other radionuclides that are present in the test sample? Surely they too can get into the detector and distort the instrument's readings. Inasmuch as the Nuklon device does not record particles in general, but only those that are genetically bound -- mother and daughter particles --, the background of random congruences is quite small. For example, that background does not exceed several impulses in a twenty-four hour period in the course of measuring weakly radioactive test samples. Radium in the test samples is assayed by a relative method in which comparative samples are employed. The assay limit is  $10^{-11}\%$  at a test weight of 5 grams and measurement time of about 30 minutes.

Because of the new method's speed, selectivity, and simplicity of analysis and high degree of accuracy, it is attracting the attention of specialists in various sectors of the national economy, science, and medicine.

The Nuklon instrument for the rapid assay of radium in powder samples. On the left hand side of the photo is the container for sample being analyzed. This is a detachable cylinder between whose two parts the sample is placed. The two-layer scintillators of the detector are exposed to the sample.



Key:

1. test sample
2. luminophore layer
3. scintillation plastic body
4. photoelectron amplifier

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6289

CSO: 1841/204

BOMBARDMENT OF CARBON-PYROCERAMIC SURFACE WITH LOW-ENERGY  $\text{He}^+$ -IONS:  
ION IMPLANTATION AND SUBSEQUENT THERMAL DESORPTION OF ATOMS

Moscow POVERKHNOST: FIZIKA, KHIMIYA, MEKhanika in Russian No 10, Oct 85  
(manuscript received 28 Dec 84; in final version 26 Feb 85) pp 31-35

GERCHIKOV, M.Yu., PANESH, A.M. and SIMONOV, A.P., Scientific Research  
Institute of Physical Chemistry imeni L.Ya. Karpov, Moscow

[Abstract] The suitability of carbon-pyroceramic for the first wall of a fusion reactor was evaluated, this material being structurally similar to granular plain pyroceramic of the 500 Å grain-size fraction and chemically composed of carbon with 10-15% boron. An experimental study of this material was made, for the purpose of determining its capability to capture low-energy  $\text{He}^+$ -ions depending on its surface state. A polished specimen of USB-15 carbon-pyroceramic, 2 mm thick and  $8 \times 8 \text{ mm}^2$  large was placed inside a LAS-600 "Riber" chamber with a residual pressure of  $2 \cdot 10^{-8}$  Pa, annealed at 1000 K for 8 h, and after each bombardment cycle heated for 1 h down to the original ambient partial helium pressure, which was monitored with a quadrupole mass-spectrometer. Bombardment was done with  $E = 140-600$  eV  $\text{He}^+$  ion beams 0.3 cm in diameter at current densities of correspondingly  $3 \cdot 10^{-7}$  -  $1 \cdot 10^{-6}$  A/cm<sup>2</sup>, in a separate chamber with  $1 \cdot 10^{-4}$  Pa helium pressure. Measurements were made with a mass-spectrometer by the thermal desorption method, helium atoms desorbed from the heated surface being recorded with a sensitivity of  $4 \cdot 10^9$  atoms/(cm<sup>2</sup>·s). The chemical composition was monitored with an Auger-electron spectroscopy. The capture or sorption coefficient, ratio of the number of atoms implanted in the surface layer to the total number of bombarding ions, was found to increase irreversibly with increasing bombardment dose and with the chemical composition of the material also irreversibly changing. The results indicate that helium atoms implanted in the surface layer of carbon-pyroceramic upon low-energy (140-600 eV) bombardment of the latter exist in two different states  $\alpha$  and  $\beta$ . The former is an aggregate of atom complexes with point defects of the vacancy kind. The latter is an aggregate of helium atoms pinned by macrodefects in that layer. Prolonged bombardment up to a dose of  $1 \cdot 10^{20}$  ions/cm<sup>2</sup> produces a new "captured" state  $\alpha_2$  which does not vanish upon further bombardment but remains localized in the upper atomic monolayers. Its activation energy is  $0.9 \pm 0.05$  eV, lower than that of  $\alpha_1$  and  $\alpha_2$  states ( $1.2 \pm 0.05$  eV), and the

sorption or capture coefficient approaches unit. Figures 3; references 9: 6 Russian, 3 Western. [195-2415]

UDC 539.211

# STUDY OF ION-BOMBARDED GaAs LAYERS BY PHOTOLUMINESCENCE AND HALL-EFFECT METHODS

Moscow POVERKHNOST: FIZIKA, KHIMIYA, MEKHANIKA in Russian No 10, Oct 85 (manuscript received 9 Apr 84; in final version 25 Mar 85) pp 48-55

BYKOVSKIY, V.A., BYCHKOV, A.G., ZUYEV, V.A., SORBINA, V.P. and TETELBAUM, A.I.

[Abstract] The results of bombarding AGP-2 GaAs layers with  $\text{Si}^+$ ,  $\text{Ar}^+$ , or  $\text{Ne}^+$  ions as well as with  $\text{Ar}^+ + \text{Si}^+$  or  $\text{Ne}^+ + \text{Si}^+$  ions were evaluated in terms of photoluminescence spectra and electrophysical properties. Layers of GaAs doped with chromium and insulated on one side, with their surface oriented at an  $8^\circ$  angle to the (100)-plane so as to prevent channel formation, were bombarded with 40 keV ions at 300 K for "cold" implantation. The dose of  $\text{Si}^+$ -ions was  $16 \mu\text{C}/\text{cm}^2$  ( $10^{14}$  ions/ $\text{cm}^2$ ) and the dose in all other cases was  $200 \mu\text{C}/\text{cm}^2$ , with  $1000 \mu\text{C}/\text{cm}^2$  of  $\text{Ar}^+$ -ions as a separate "large" dose item for comparison. After bombardment, these specimens were annealed by heat treatment for 30 min in a stream of dry argon, or under a  $0.3\text{--}0.35 \mu\text{m}$  thick protective  $\text{SiO}_2$  film, or in a mixture of superpure graphite powder and AGP-2 GaAs powder. Photoluminescence after bombardment and after heat treatment was induced by means of a continuous-wave He-Ne laser (wavelength  $\lambda = 632.8 \text{ nm}$ ) with a maximum radiation intensity of  $10^{20} \text{ cm}^{-2}\text{s}^{-1}$  in the focused beam. The photoluminescence spectrum within the  $1.0\text{--}1.6 \text{ eV}$  energy range was analyzed with IKM-1 or SDL-1 monochromators, the dispersion not exceeding  $5 \text{ meV/mm}$ , and was recorded by an FEU-2 photomultiplier as well as by PbS and Ge(Cu) photodetectors. The electrical conductivity and the Hall effect were measured by the Van der Pauw method through Sn point contacts. The principal measurements were made at  $4.2 \text{ K}$ , some measurements were made over the  $4.2\text{--}300 \text{ K}$  temperature range. The main feature of the photoluminescence spectra after ion implantation is their retention despite subsequent annealing at temperatures up to  $873 \text{ K}$  or, in the case of "large" bombardment dose, even after annealing at temperatures up to  $973 \text{ K}$ . The spectra of implanted but unannealed GaAs did not depend on the kind of bombarding ions, whether in a single bombardment with one kind or in a double bombardment with two kinds. A sharp  $I_g$ -band peak at  $1.22\text{--}1.23 \text{ eV}$  appeared in the spectra of GaAs with single ion implantation but vanished completely, along with other peaks, after annealing at  $1173 \text{ K}$ . It also vanished after second ion implantation before annealing. The results can be interpreted as follows. Bombarding ions of an inert gas generates additional defects in GaAs, which during annealing transform into dislocation loops and as such act as getters for uncontrolled impurities as well as for point defects released upon thermal breakup of clusters or other complexes



formed during bombardment. The effectiveness of these getters can increase upon their absorption by implanted silicon, either because of higher elastic stresses or because of changing bonds in the dislocation nuclei. The photoluminescence spectra after annealing are generally Gaussian ones. Theoretical data and experimental data, including data on electron concentration and electron mobility, are quantitatively reconcilable by an anomalously high diffusion coefficient of the order of  $10^{-12}$  cm<sup>2</sup>/s. Figures 6; references 14: 11 Russian, 3 Western.  
[195-2415]

UDC 543.422.541.183

ELECTRON PARAMAGNETIC RESONANCE SPECTRUM OF SILVER ATOMS IN GAMMA  
IRRADIATED ZEOCAR-2

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 5 Jan 84) pp 2555-2557

POPOVICH, G.M., MIKULSHINA, N.P. and BUGAYENKO, L.T.

[Abstract] The purpose of this work was to determine the possibility of formation and stabilization of silver atoms in the gamma irradiated commercial catalyst Zeocar-2. EPR spectra of gamma-irradiated Zeocar-2 containing silver ions adsorbed on the surface of silver atoms were observed at liquid nitrogen temperatures. The components of the spectra were asymmetrical, the extent depending on concentration of silver nitrate solution, radiation dose and temperature. The asymmetry decreases with increasing radiation dose, increasing temperature and decreasing silver nitrate concentration used to process the carrier. The composition of the spectra is described. Introduction of silver ions and subsequent careful washing of the specimen with distilled water eliminates the salt anion in the gamma irradiated matrix. The Ag<sup>II</sup> signal is found to belong to the silver atom and is characterized by a positive shift in splitting of the superfine structure, characteristic for silver atoms adsorbed onto the surfaces of solids. The silver atoms stabilized on the surface of the carrier are in restricted capture locations under slight compression. Figures 2; references 7: 4 Russian, 3 Western.  
[220-6508]

## DIFFUSION OF TRITIUM IN LITHIUM-BORATE GLASS

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85  
(manuscript received 12 Jul 84) pp 2579-2581

KHODYAKOV, A.A., BOGDANOV, V.L., GROMOV, V.V., DUBROVIN, A.L., SAUNIN, Ye.I.,  
and FEDORUSHKOVA, Ye.V., USSR Academy of Sciences, Institute of Physical  
Chemistry, Moscow; Leningrad Institute of Technology imeni Lensovet

[Abstract] A radioactive isotope of hydrogen is used to determine the parameters of diffusion in lithium-borate glass, allowing the radiometric method to be used. The charge composition was 30%  $\text{Li}_2\text{O}$ , 70%  $\text{B}_2\text{O}_3$ . Specimens were synthesized in a platinum crucible, 1 hour in air. Diffusion of tritium was studied upon thermal extraction of this isotope under isothermal and isochronic conditions. The changes occurring in the specimens during heating were studied by thermal analysis. Beginning at a certain moment in time, depending on temperature, the rate of the process of extraction of tritium is limited by the rate of volumetric diffusion. The values of  $D$  obtained indicate the possibility of a process of associative-dissociative chemical interaction occurring in conjugation with diffusion and the participation of the hydroxyl ion or ion complex in diffusion (oxonium). Figures 2; references 5: 1 Russian, 4 Western.  
[220-6508]

UDC 537.226

## COMPLEX DIELECTRIC PERMEABILITY AND DIELECTRIC RELAXATION OF HEAVY WATER ALONG ITS CURVE OF EXISTENCE

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85  
(manuscript received 30 Oct 84) pp 2639-2641

NABOKOV, O.A. and LYUBIMOV, Yu.A., Chemistry Faculty, Moscow State University  
imeni M.V. Lomonosov

[Abstract] The authors previously studied the complex dielectric permeability of ordinary water at 70-200°C. Similar measurements were performed in this work for  $\text{D}_2\text{O}$  by incomplete filling of a microwave resonator at a frequency of about 9.3 GHz. Distilled 99.8%  $\text{D}_2\text{O}$  was used. For  $\text{D}_2\text{O}$ , the value of  $\tau_D T / \eta$  (where  $\eta$  is the viscosity) increases with increasing temperature, so that at 140°C its change goes beyond the limits of error of the measurement of  $\tau_D$  and  $\eta$ . The gradual increase in  $\tau_D T / \eta$  and  $\tau_D$  with temperature indicates weakening of the interaction between orientation and translation movements of the liquid  $\text{D}_2\text{O}$  molecules with increasing temperature. Figure 1; references 11: 5 Russian, 6 Western.  
[220-6508]

# PHOTOSTIMULATED EXCHANGE OF URANYL OXIDE IN AQUEOUS SOLUTIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 285, No 3, Nov 85  
(manuscript received 25 Jan 85) pp 630-633

GAZIYEV, S.A., GORSHKOV, N.G., MASHIROV, L.G. and SUGLOBOV, D.N.

[Abstract] The  $\text{UO}_2(\text{ClO}_4)_5 \cdot 5\text{H}_2\text{O}$  salt was kept in  $\text{H}_2\text{O}^{18}$  at pH 3 for 2 days to introduce  $\text{O}^{18}$  isotope into the salt which was then dissolved in  $\text{H}_2\text{O}$ . The solution was irradiated with light impulses from a xenon lamp (impulse length 1.5 msec, light length 4 nm) in the presence of He bubbling through. The replacement of  $\text{O}^{18}$  isotope with  $\text{O}^{16}$  in the salt was determined by an IR method as an indication of oxygen exchange. The degree of oxygen exchange varied with the presence and concentration of  $\text{HClO}_4$ ,  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ ,  $\text{C}_2\text{H}_5\text{OH}$ , an  $\text{Mg}^{2+}$ ,  $\text{La}^{3+}$ ,  $\text{Th}^{4+}$ ,  $\text{Ce}^{3+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{CHCOO}^{1-}$ ,  $\text{CO}_3^{2-}$ ,  $\text{Cl}^{1-}$  and  $\text{Br}^{1-}$  ions. Figures 2; references 11: 3 Russian, 8 Western  
[219-12928]

UDC: 632.93:631.53.01

# PLASMA TREATMENT OF SEEDS INEFFECTIVE IN DISEASE CONTROL

Moscow ZASHCHITA RASTENIY in Russian No 8, Aug 85 pp 29-30

TUYTEREV, S.L., chief, Department of Phytotoxicology and Biochemistry, All-Union Institute of Plant Protection, KRONBERG, A.G., Senior Agronomist, and DMITRIYEV, A.P., Senior Scientific Associate

[Abstract] Attempts have been made to use various physical methods such as radiation, plasma and electromagnetic waves to treat seeds to improve their resistance to disease. Unfortunately, all such methods with the exception of heat treatment are still in the research stages, and have not been shown to achieve the desired effects. In spite of this, physical methods of seed treatment are being loudly promoted instead of traditional chemical methods in certain areas of the Soviet Union. The result has been a sharp increase in losses due to head diseases and root rot. The authors' Institute has tested the 04 FP-1 device suggested by the All-Union Scientific Research Institute of Electrification of Agriculture for two years (1983-1984) on barley, wheat and oats. No significant improvements were found, and in all cases treatment with traditional substances such as Vitavax was superior to plasma treatment. The tests indicate that treatment with the 04 FP-1 machine has no effect on barley powder head pathogen, does not prevent the development of root rot and does not protect winter wheat from hard head. The device cannot be recommended for production.  
[145-6508]

## RUBBER AND ELASTOMERS

### DEVELOPMENT OF USSR RUBBER INDUSTRY

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 12 Sep 85 p 3

[Article by V. Nikandrov (director, Yaroslavl Synthetic Rubber Plant) and G. Sakhapov (director, production association "Nizhnekamskneftekhim")]

[Text] The domestic industry manufactures different types and marks of synthetic rubbers. The most widely used and manufactured are isoprene and divinyl rubbers, analogous to natural rubber in structure and properties.

In the 60's the decision was made to increase sharply the manufacture of synthetic rubber. This was necessary due to the construction of automobile manufacturing plants, the increase in automobile parks and consequently, the sharply growing demand for automobile tires. But the increase in the output of rubber to a large extent was held back by the aging, small capacity, highly caustic, energy consuming imported equipment. The production quality obtained from it far from satisfied the demands. Therefore, it was necessary to create domestic equipment for large-scale production, based on an essentially new technological method.

Such a method was the so-called mechanothermal method of dehydration of rubber using extruding machines. On the basis of it automatic lines for separating synthetic rubbers were also created. The operations were done by specialists from the Leningrad Scientific Research and Construction Institute of Chemical Machine Building, the Ural Production Association for Chemical Machine Construction, the people's enterprise "Buzuluk (Czechoslovak Socialist Republic), and the All Union Industrial Association "Soyuzkauchuk." The first large tonnage line for manufacturing divinyl rubber was introduced at the Yefremovskiy Synthetic Rubber Plant. And the first line for isoprene rubber was put into use by the production association "Nizhnekamskneftekh."

From the very beginning, the lines were automated. They were equipped with automatic process control systems, which ensured an optimal technological regime, stable quality and operational.

Attempts to create similar lines were undertaken abroad. The lines of certain American firms were even purchased and installed. However the experience of comparative use showed the essential advantage of domestic lines

in operational, technological and economic indices. The equipment created was capable of competing in the world marketplace. Thanks to it the demand by the domestic economy for high quality rubber has been satisfied.

The enormous contribution in creating the line by the workers of the plant "Buzuluk" from the Czechoslovak Socialist Republic should not be ignored. Their knowledge and experience made it possible to reduce the length of the pressing cycle which made it possible to equip the line with two presses instead of four in the design.

The joint work of the Soviet and Czechoslovak specialists, "The Creation and Founding of Serial Production, Organization of Fully Equipped Sets and the Introduction of Automated Lines for Separating Synthetic Rubber for Productivity of 8,000, 4,000 and 1,000 Persons," completed by B. Prudovskiy, Ya. Yechmen, G. Arkhinov and others, has been meritoriously nominated for competition for the USSR State Prize.

12318

CSO: 1841/26

UDC: 541(127+64):547.1'128

MACROKINETICS OF STRUCTURING OF LOW-MOLECULAR WEIGHT ORGANOSILICON RUBBERS

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85 (manuscript received 19 Feb 84) pp 2040-2047

MALKIN, A.Ya., KULICHIKHIN, S.G., NARODITSKAYA, Ye.Ya., POZDNYAKOV, V.Ya., YUNITSKIY, I.N. and KIREYEV, V.V., Scientific-Production Association "Plastmassy," All-Union Scientific Research and Planning Institute of the Chemical Industry; Moscow Institute of Precision Chemical Technology imeni M.V. Lomonosov

[Abstract] A study was made of the rheokinetic characteristics of structuring of SKTM-G polydimethyl siloxane rubber and copolymers of siloxanes with styrene, cross-linked with tetraethoxysilane in the presence of tin octoate as a catalyst. Experiments were performed on the elastoviscosimeter at 20-90°C. Curing was performed at temperatures significantly greater than the glass point of the polymer. A rheokinetic model of the process of structure formation is suggested, indicating that it is a reaction which includes acceleration. A macrokinetic description of changes in viscoelastic properties in the process of structure formation of low-molecular organosilicon rubbers and their copolymers with styrene is suggested and numerical values are determined for constants included in the rheokinetic equations. Figures 9, references 20: 14 Russian, 6 Western. [178-6508]

UDC: 541.64:546.22

DISTRIBUTION OF SULFUR IN VULCANIZATION OF ELASTOMER MIXTURES

Moscow VYSOKOMOLEKULYARNYYE SOYEDINENIYA in Russian Vol 27, No 10, Oct 85 (manuscript received 10 Mar 84) pp 2125-2130

SHUTILIN, Yu.F., Voronezh Institute of Technology

[Abstract] The distribution and solubility of cross-linking ingredients among raw rubbers at various temperatures have been studied, but little

attention has been given to problems of the distribution of vulcanizing agents in vulcanizates, including filled vulcanizates. This article studies composites based on SKD, SKI-3, SKS-30 ark and SKN-40 raw rubbers and their mixtures containing (n weight parts per 100 weight parts raw rubber): stearin 2.0, zinc oxide 5.0, phenyl-beta-naphthylamine 0.5 and sulfur, 2 to 30, yielding primarily polysulfide attachment of the sulfur. The sulfur is distributed in the raw mixtures according to its affinity for the elastomers and has a significant influence on the vulcanization process, during which it is redistributed due to differences in initial and final activities and diffusion properties of the rubbers. Technical carbon changes the vulcanization and diffusion characteristics of the elastomers, changing the rates of attachment and migration of sulfur. Figure 1, references 18: 16 Russian, 2 Western. [178-6508]

#### POLYACROLEIN LATEXES: SYNTHESIS, ADDITION OF FILLING AGENTS AND FORMATION MECHANISM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 285, No 1, 1985 (manuscript received 27 May 85) pp 159-161

LUKIN, Yu.V., BAKHAREV, V.N., ZAICHENKO, A.S., VORONOV, S.A., ZUBOV, V.P. and GRITSKOVA, I.A. (deceased), corresponding member of SSSR Academy of Sciences, PRAVEDNIKOV, A.N.

[Abstract] Polymerization of acrolein from its aqueous alkaline solution containing 2-6% acrolein in the presence of 0.001-0.12 wt.% copolymer of vinyl acetate, acrylic acid, and dimethylvinylethynylmethyl hydroperoxide as emulsifier was studied. A decrease in the emulsifier concentration from 0.12 to 0.001 wt.% increased the diameter of polyacrolein latex spheres from 0.35 to 0.60  $\mu\text{m}$ . An increase in the solution concentration from 2 to 6% acrolein increased the latex sphere diameter from 0.2 to 0.6  $\mu\text{m}$ . Addition of acrolein at the end of initial polymerization period of 30 min increased the latex sphere diameter to 2  $\mu\text{m}$ . The same increase was observed while conducting gradual polymerization of acrolein at 15% increments based on the initial monomer amount. Polymerization of acrolein in the presence of dispersed magnetite, malachite green, pyromine and other undefined filling agents produced polyacrolein latex with the filling agent's color. The biochemical usefulness was shown by using 1 mg latex with sphere diameter 1.2  $\mu\text{m}$  to bind 8  $\mu\text{g}$  human IgG ligand. Figures 3; references 5: 1 Russian, 4 Western. [166-12928]

## WATER TREATMENT

### EXPERIMENTAL MUNICIPAL WATER SYSTEM TO BE EXPANDED

Moscow VODOSNABZHENIYE I SANITARNAYA TEKHNIKA in Russian No 10, Oct 85 pp 2-4

[Article by I. V. Kozhinov, candidate of technical sciences, director of the Organization and Management Laboratory of the KVOV [as published] Scientific Research Institute, under the rubric: "Toward the CPSU 27th Congress!" rubric: "From Experiment to a New System of Economic Operation"]

[Text] The decree of the CPSU Central Committee and the USSR Council of Ministers, "The Wide Dissemination of New Methods of Economic Operation and Intensification of their Influence on the Acceleration of Scientific and Technical Progress" has paramount significance for municipal water systems, which fulfill an important social economic function. The sector is characterized by large-scale production, organizational-technical integrity, a complex sector and territorial structure, development according to a plan directed toward the satisfaction of all growing needs of the population and the national economy for water of drinking quality and for discharge and purification of wastewater for natural storage and hydroeconomic purposes.

The large scales of the branch can be judged by the following data. In 1983, the total amount of water supplied only by municipal water systems of the RSFSR comprised 12.5 billion m<sup>3</sup>, which it has doubled in the last 15 years. The amount of water supplied per inhabitant reached 288 liters per day and on the whole is sufficient for continuous supplying of the population with good quality drinking water. The volume of water discharged for these same years grew by a factor of 2.1, while the proportion of purified wastewater increased from 49 to 72.5 percent. The branch basically is comprised of qualified cadres.

Rapid development of the sector due to new construction, modernization, and further improvement of the technical operation of existing industrial plants enabled the task posed by the CPSU 24th Congress to be solved for provision of cities and working settlements with a centralized water supply. The successes achieved in such a brief time are extremely significant, but cases in which the water system is organized unsatisfactorily, the water reaches the population intermittently and overexpenditure for it, in both energy and material resources, is still not unusual.

Elimination of these deficiencies depends on the management of water and sewage enterprises and on the specific organization of the work. Improvement of the



management includes large resources for raising labor productivity, to be computed according to the final effect on the national economy. In a water and sewage system, the connection between volumes of production and labor costs bears a mediocre character: the volume of the water supply (purification of wastewater) is independent of the number of personnel employed and their skills. But the economy of water reagents and energy expenditures when more productive and reliable technological processes are introduced, by providing the possibility of expanding the areas of service to the population and an increase in efficiency and quality of work, simultaneously leads to a lowering of labor costs (increase in labor productivity) in mining sectors of industry or for water consumers.

Improvement in management is not reduced, as sometimes it is understood, to the use of computer engineering, EDP. With all their efficiency, these means in themselves do not produce a large-scale result, if simultaneously economic goals and management tasks are not defined more accurately. Thus, deficiencies in management and underestimation of scientific and technical progress frequently are the reasons for an unsatisfactory water supply, low quality of the purification of natural waters and wastewater, and well-based complaints of the people about interruption of the water supply, in spite of considerable (several hundred liters per person) relative outlays.

Scientific and technical progress is intimately related to the economic mechanism. Technical progress is not only new technology and equipment for purification, supply and discharge of water, but also the improvement of management at all levels and the calculation of economic factors in working scientific and technical problems. This relationship must not be understood narrowly, in the sense that new technology or methods of calculation provide only a direct technical-economic effect (for example, lowering the expenditures cited); it implies more complete interpenetration. It is necessary to balance the introduction of new engineering with the plan tasks and indicators being established, and also with material and financial resources. In addition, besides a general increase in the efficiency of production (growth of labor productivity with minimal expenditures), in which the national economy is interested, the use of new engineering must give social and economic advantages to the collectives of planning, construction and operating organizations of the water and sewer systems' economies.

Unfortunately, this has not yet been achieved for today, because the specific economics of the sector for many years has not been paid proper attention, and because of carelessness in formulating economic problems, mechanical copying and transfer of economic plans from production areas to the water and sewage system without taking into account that its specifics gave rise to a number of inconsistencies between the interests of enterprises of the sector and the national economy. It is advantageous to the national economy for water to be consumed efficiently, without waste, so that the most consumers, primarily the population, are satisfied by the least amount of it at minimal costs. It is advantageous to the enterprise to produce more water and to supply it at the highest price for industrial needs, because this increases fulfillment of the plan in monetary terms.

Such a discrepancy of interests is explained by the fact that in the sector, as well as in industry, the system of distribution of capital outlays for material and technical supply, financing, wages, and social and cultural construction, in a word, the whole system of indicators which determine the possibilities of enterprises to satisfy the needs of workers, and the outlooks for social and economic development of collectives are placed in direct dependence on the cost volumes and tempos of production development. The higher the volumes, the greater the possibilities the enterprises have available. Under these conditions, the striving to reach an increase in value scales of production does not always show subordination to the needs of the national economy, and sometimes becomes an end in itself. Enterprises strive to develop new capital funds, although their basic funds may be used unsatisfactorily, or the organization of the work itself does not enable an uninterrupted water supply to be regulated. This leads to a rise in publicly necessary expenditures, while they are not accompanied by a corresponding increase in real terms of delivery of water (which is possible because the difference in water rates for different categories of consumers) or by an improvement in its quality. Thus, labor and means expended for new industrial plants, the introduction of which in a given time period is essentially untimely, by establishing the appearance of a growth of the scales of production and an improvement in the economic position, do not serve as a factor in the actual improvement of the water supply of the population and, consequently, prove to be unwarranted.

These circumstances were also taken into consideration previously. However, it did not appear of proper urgency in the solution of economic problems, inertia of thought was shown, and an understanding of the specific situation was reinforced by daily tedious work. Now, the problems of improvement of management, planning and economic stimulation stand before the municipal water economy in all its acuteness, the solution of which enables a conversion to the intensive principles of economic operation to be assured, the influence of scientific and technical achievements to be raised in effectiveness, the policies of conservation of resources, and, most of all, conservation of water, to be conducted purposefully,

The first experiment of such a reorganization in the sector was undertaken in 1979, after the issuing of the decree of the CPSU Central Committee and the USSR Council of Ministers, "Improvement in the Planning and Strengthening of the Influence of the Economic Mechanism for Increasing the Efficiency of Production and the Quality of Work". This experiment was related to an attempt to solve the relatively modest and special, as it seemed then, task of overcoming obstacles of an economic character, which are hindering the collectives of the water supply enterprises from carrying on work on the elimination of all forms of waste of water. Then, together with the development of the corresponding proposals, preparation was begun for conducting an economic experiment. According to the decree of the USSR Gosplan, the experiment was conducted in 1980-1983 on the basis of water and sewage enterprises of the cities Vyborg, Kirishi and Salavat under the scientific-methodical leadership of the KVOV [as published] Scientific Research Institute.

The normative method of planning is the basis of the experiment, i.e., the development of the production program in natural indicators on a normative basis, providing efficient consumption of water with the establishment of

tasks to decrease its waste. The marginal norm of the water requirement of the population, the directed period of its achievement and the plan tasks for delivery of water in a calculation per inhabitant per year was established for the water system enterprise. The sums of the revenues for delivery of water and sewerage services for the population (within the limits of the tasks established) and not exceeding the plan sum of expenditures for production activity appear as capital-forming indicators. The first indicator reflects in economic terms the state of the provision of the population with water, the second aims toward the fulfillment of the plan tasks with the least expenses. Thus, a trend toward the improvement of capital-forming indicators was noted--a conversion to indicators characterizing the efficiency, quality, and final result. The place of profits in the system of capital formation is changing: from a capital-forming indicator, it is converted into a capital-forming factor; norms of deductions are established in percentages of the standardly calculated profits.

Experiment confirmed that in the conversion to new conditions of economic operation, great possibilities are discovered for achieving an important economy of water with simultaneous improvement of an uninterrupted supply of it because of more efficient redistribution among consumers. For example, the city of Salavat with an actual consumption of water of 308 liters per person per day had not been satisfactory, but an uninterrupted supply for the population has been provided practically down to normal (230 liters per person per day) with a reduction of water consumption because of the elimination of waste of water in buildings.

Beginning in 1985, according to the decree of the USSR Gosplan, the experiment is being expanded to all water and sewage enterprises of the Leningrad Oblast and the Bashkir ASSR, and in 1986-1987, further introduction of new methods of planning are anticipated.

Now, it is already evident that the experience obtained in the course of the experiment was directed toward the improvement of the economic operational mechanism of the sector upon the whole, and not only for the solution of tasks of the economy of water, although this task, as the weightiest factor in increasing the productivity of labor and the economy of resources, has, as before, prevailing importance. Experiment showed that economy of water should be considered as a secondary, supplementary source of the water supply, a resource which it is necessary to bring into operation everywhere. The quality of water must not be permitted a natural course free from control. Economy of water is necessary not only because it provides a lowering of expenditures, but without it, it is practically impossible to organize a normal water supply. There are water system enterprises in the country which, in power and volume of delivery of water, as a minimum are doubly exceeding the level of efficient water consumption. In spite of this, the population is supplied with water intermittently, irregularly or completely according to schedule because of unsatisfactory control of consumption and waste of water.

At the present time, the task of water economy has outgrown the sector, especially the technological character; it has become a matter of state importance, although the narrowness of the search for acceptable solutions at technological or sector levels did not decrease from this.

Under new conditions of economic operation, the water system enterprises pattern their work not on the "level achieved" but on the basis of the evaluation of the requirement for water, whereupon there is an efficient requirement for all categories of users. The experiment is a search; much of its situation needs amplification and careful checking with the results of work with the vitally important requirements of the enterprises. A large amount of work still lies ahead in the continued search for optimal methods of economic operation. Their total purport must lead to the replacement of the directive regulation of each step of the leader with the sum of economic influence directing the work of the water and sewage enterprises. The leadership of the enterprises should grant broad powers, including financial, by requiring that they regulate the appropriate water supply (discharge) with the economic work of the enterprise. When it is taken into consideration that this is achieved by the introduction of the achievements of science and engineering, measures should be evaluated from this point of view for the improvement of the economic operating mechanism, whether they accelerate or retard technical progress and whether they change the conditions under which acceptance of the new technology will be advantageous to the collective. In other words, the task continues to make the economics of the sector maximally receptive to science and engineering progress, to provide a vital interest of the workers in increasing the efficiency and the technical level of production and to accelerate the conversion to an intensive way of development and path of modernization and technical renovation. Stimulation of the growth of efficiency of production and quality of service of the population must be provided by a whole system of economic levers, indicators and norms regulating the distribution of capital for wages.

It remains to impart a new impetus to work on continued formation of production associations in the water and sewage economy. They are becoming a basic self-financing link of management and simultaneously a project of centralized state planning. The associations must be completely responsible for the organization of self-financing, both for enterprises subordinate to them and also among these enterprises. By means of the distribution and finishing of tasks, and also the distribution of capital, means of stimulation, and the limitation of current accounts, they can prove to be an effective influence on the planned work of enterprises. By eliminating excess governmental apparatus links at workplaces and by promoting reduction in the numbers of administrative-management personnel, they enable the task of alignment of the possibilities of continuing social and economic development of collectives to be solved because of the concentration and purposeful use of resources.

It also remains to reconsider the capital investment policy and the order of distribution of resources in the development of annual and five-year plans. An increase in industrial plants without leading development of technology, without introduction of new equipment, without improvement in management, and without the solution of organizational-technical tasks does not raise the level and quality of service of the population, even though the productivity also rises.

The modernization and technical renovation of water and sewage enterprises based on the introduction of new engineering and technology and the organization of economical and efficient use of water must occupy a central place in the implementation of capital outlays. It is necessary to prevent attempts

in the form of modernization to implement mechanical reproduction of structures already in existence by a quantitative increase in their productive capacities. It is necessary to establish conditions under which it will be advantageous to the enterprises to go to new construction or modernization only in the case in which all resources for an increase in production, a rise in the quality of water purification, supply and discharge have been exhausted. Rejection of this course would lead to excessive public expenses, which the national economy must avoid. The traditional look at new construction arose as the result of free and permanent obtaining of capital outlays from the state budget and the insensitivity of leaders to use each ruble efficiently. Therefore, it is necessary to reconsider the structure of the capital outlay policy and change and tighten the order of expert examination of new construction, and solve the problem of the apportionment of material resources, primarily for enterprises implementing renovation of their production.

It is necessary to secure the interest of workers of the planning organizations in the introduction of new engineering and in lowering the cost of construction. Ways to overcome a rise in cost of the projects are numerous. One way, for example, is a rise in the quality of planning-budget documentation based on more carefully conducted preplanning investigations and research, the selection of a generally less capital-intensive variant, the development of industrial plants owing to modernization on a new technological base, and the use of approved and economical model projects. A total economy of the means for capital outlay is achieved by means of the least capital-intensive variants of the solution, for example, because of intensification of measures for elimination of waste of water together with increasing the volume of its production and supply even at the development stage of the project. To solve this task requires review of the indicators set and stimuli of the work in the planning organizations.

The course for the intensive development of economics assumes economy and strict observance of the norms of expenditures for raw materials and other materials. There is little to spend, and much to be done--such an approach must become the main criterion in the evaluation of successes of any labor collective. Therefore, it is necessary to strengthen attention on the processing and use of secondary resources: purified wastewater--for industrial water supply or agricultural irrigation, processed sediments as fertilizers, and exhaust gases as a fuel-energy resource. It is known that expenditures for the processing and utilization of secondary resources are considerably less than for the extraction of primary materials. This in itself already must give first place to secondary resources. And here until now, the lack of solution of organizational-economic problems, most of all stimulation and price-setting, remains the main repressing factor which hinders an increase in the proportion of usable secondary resources of the sector and does not enable plans to be made for utilization intensively.

In a municipal water operation, solutions of the tasks of social development depend a great deal on the quality and efficiency of the work of the enterprises of the sector, which are dynamic systems with the participation of people. This characteristic is related, on the one hand, to the task of satisfaction of the material and social requirements of each worker, and, on the

other hand, to an increase in the role of the "human factor" in the development of production and an increase in its influence on the improvement of the work of the enterprise. For successful solution of social problems, efforts are required which are related to raising the level of education and skill of workers, decreasing the proportion of heavy manual and monotonous labor and continuing improvement of its mechanical and energy equipment, and also regulation of wages.

The improvement of the economic operational mechanism is not a simple matter. The task of maximal acceleration of scientific and technical progress in the sector is still not solved; the problems of raising the responsibility of the highest management teams also has not been solved. In addition, the labor collectives still have not used all resources for intensification of production.

The successful conclusion of the experiment and its conversion to a viable system of economic operation are possible only by the pooling of the combined efforts of the planning agencies, the RSFSR Ministry of Municipal Services and enterprises of water and sewage systems.

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## FLOTATION PURIFICATION OF SHIP-BORNE PETROLEUM-CONTAINING WATERS

Moscow VODOSNABZHENIYE I SANITARNAYA TEKHNIKA in Russian No 10, Oct 85 pp 6-8

KARELIN, Ya.A.\*, doctor of technical sciences, BOGDANOV, V.F.\*\* and ZASLAVSKIY, Yu.A.\*\*, candidates of Technical Sciences; \*Moscow Engineering Construction Institute imeni V.V. Kuybyshev; \*\*Far Eastern Polytechnic Institute imeni V.V. Kuybyshev

[Abstract] Multistage flotation cells were used to purify ship-borne waste water by flow aeration. The aerating water was forced through a nozzle at high speed and then into a flotation chamber through a cylindrical nozzle shield positioned 0.01-0.03 m into the water. This stream carried a large amount of entrained air deep into the water being treated. Flotation speed increased with depth of penetration of the water-air jet, the rate of air input, the salt content of the water, the liquid flow rate through the flotation cell, and the decrease of the cross section of the water being treated. An increasing NaCl content not only facilitated complex-formation, but also sharply increased the dispersion of air bubbles in the aerating stream. With a 10-15 fold recirculation, the concentration of petroleum products in sea water dropped to the limits of solubility of the heavier molecules (2-5 mg/l). A multistage flotation apparatus can have treated water flowing from one cell into the next through a channel formed by adjacent cell walls, with petroleum-containing foam collected off the top in a side channel. Experiment showed an optimum angle of entry for the aerating stream of 7-15° from the vertical, with a pressure of 0.3-0.5 MPa in the collecting chamber for the aerating water (recirculating purified water). This gave good dispersion of the entrained air, increased the penetration depth of the air-water stream, and provided a coefficient of aeration (ratio of the volume of entrained air to the flow of liquid through the aerating nozzle) of 8-11 with an acceptable recirculation rate (ratio of the input of purified water diverted through the aeration system to the input of untreated water). An experimental 18-cell apparatus with a working volume of 1.17 m<sup>3</sup> and a depth of 0.65 m used an aeration pressure of 0.2-0.33 MPa, an input of raw water of 1.92 to 3 m<sup>3</sup> and a recirculation rate of 0.53 to 1.52. It treated water with 53-8400 mg/l of petroleum products at a pH of 7.26-7.56, a salt content of 28.5-33 kg/m<sup>3</sup>, and a temperature of 6-20° C. High concentrations of contaminants had little effect on the process as the grossly dispersed petroleum products were effectively removed in the first

few stages. The concentration of emulsified petroleum products was lowered from 53-350 to 6.2-8.6 kg/l at an overall flow rate of 2.5 m<sup>3</sup>/h. This provided better purification than impeller or coalescence methods at a cost 1.5 to 2 times lower, with an apparatus that can be used on shore or shipboard. Figures 2; references 3 (Russian).  
[202-12672]

UDC 628.356.3

# INTENSIFICATION OF INSTALLATIONS FOR BIOLOGICAL PURIFICATION IN SUGAR PRODUCTION PLANTS

Moscow VODOSNABZHENIYE I SANITARNAYA TEKHNIKA in Russian No 10, Oct 85 p 19

DEMIDOV, O.V.\*, SIDOROV, I.A.\*, candidates of technical sciences; KLEYMAN, M.B.\*\*\*, SADYREV, B.D.\*\*, and STEFANOV, I.A.\*\*, Engineers; \*All-Union Scientific Research Institute of Water Supply, Sewage, Hydrotechnical Installations and Engineering Hydrogeology, \*\*Giprosakhprom [State Institute for Designing Enterprises for the Sugar Industry]

[Abstract] The use of installations for artificial biological purification by comparison with traditional field filtration allows significant amounts of arable land to be freed (230-270 ha for a sugar beet plant processing 3000 t/day) and greatly reduces expenses (630-740 thousand rubles a year for a plant this size). Based on measurements of operating purification installations and further experimentation, a pilot plant installation for processing waste waters from sugar processing was developed with initial settling tanks and two-stage aeration-settling tanks with forced circulation of active sludge and a height-stabilized suspended filter. These tanks were of the corridor type, with longitudinal inclined dividers forming an aeration zone and a settling zone. Bottom slits allowed sludge to move from the aeration zone into the settling zone, where sludge hoppers with airlifts recirculated it. The design provided a high concentration of active sludge in the aeration zone and a more complete separation of sludge by the suspended filters. The pilot plant was designed to handle 10,000 m<sup>3</sup> per day with an initial biochemical oxygen demand of 1100 mg/l, reduced to 200 mg/l by the first stage purification and to 15 mg/l by the second stage. The concentration of suspended solids was similarly reduced from as much as 300 to 150 and then 15 mg/l. Overall, this approach allowed reduction of capital expenses by 26%, operating expenses by 28%, relative capital expenditures per cubic meter of treated water by 31.4%, consumption of metal and cement by 10%, and installation area by 33.3%. References 4 (Russian).  
[202-12672]



## TESTING OF JET SEPARATORS FOR CONCENTRATING ACTIVATED SLUDGE

Moscow VODOSNABZHENIYE I SANITARNAYA TEKHNIKA in Russian No 10, Oct 85 pp 23-24

KHUDYAKOV, B.N., AROMATOV, Yu.L., Engineers, GOLENISHCHEVA, E.V., candidate of technical sciences, SHISHMAKOV, S.Yu., Engineer\*, ZAYEN, I.Kh., candidate of technical sciences\*\*; \*Sverdniikhimmash [Sverdlovsk Scientific Research Institute of Chemical Machine Building?]; \*\*Scientific Research Institute KVOV

[Abstract] Four centrifugal separators were tested for their efficiency in processing waste waters. Separator DSG-35 was able to process 6-16 m<sup>3</sup>/h containing 6-8 kg/m<sup>3</sup> of solids with an overall efficiency of 94-95% removal of solids. Separators NV-600M and SDS-631K were tested in more detail in a two-stage separation process. The NV-600M has a stack of conical plates on the central rotor; fine particles settle in the spaces between the plates, migrate to the periphery and accumulate on the rotor housing where a collecting spiral brings them to a central jet exit and a sediment collector. The SDS-631K also uses a plate arrangement, but allows for recirculation of the centrifuged liquid. Experiments with feed rates of 16 to 28 m<sup>3</sup>/h and concentrations of activated sludge of 3-5 kg/m<sup>3</sup> showed the NV-600M gave a higher solid phase concentration than the SDS-631K (60-70 versus 40 kg/m<sup>3</sup>). It also did not require disassembly for washing and was able to process liquid with particles up to 0.8 mm, while particles over 0.2-0.3 mm clogged the SDS-631K. Because of the higher rotational speed of the latter, the energy consumption for the two separators was comparable. Both of them were recommended for series production. Based on the performance of these two separators, an experimental separator, NV-750 was designed and manufactured. It has a design process rate of 80 m<sup>3</sup>/h and gave positive results on preliminary tests. Figures 3; references 1 (Russian). [202-12672]

## AUTOMATION OF MONITORING OF SULFIDE IONS IN WASTE WATERS

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 118, No 2, May 85 pp 349-352

ERISTAVI, V.D., MAKHAROBlishvili, N.G., ALEKSIDZE, N.I. and DEMETRADZE, M.B., Georgian Polytechnic Institute imeni V.I. Lenin

[Abstract] Spectrophotometric, photocolormetric, and potentiometric methods were evaluated for automatic determination of sulfide ions in waste waters at 6-10 µg/L concentration. The best results (+5% accuracy) were obtained with a photocolormetric method using N,N'-dimethylparaphenylenediamine as a reagent. Detailed description of the method is given. Figures 2; references 0. [168-12928]

UDC 543.062

COMPARATIVE ANALYSIS OF METHODS FOR DETERMINATION OF SULFURIC ACID AND ALUMINUM SULFATE IN SETTLING TANKS AT VISCOSE FACILITY

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 20 Dec 84) pp 57-58

MATVEYKO, L.V., BOGOSLOVSKAYA, T.N., AREFYEVA, M.M. and DIBROVA, A.K.

[Abstract] Several methods were tested for suitability for determination of sulfuric acid and aluminum sulfate in settling tanks at viscose plants, in view of the possible replacement of zinc sulfate by aluminum sulfate in viscose production. The optimal method for sulfuric acid determination under the conditions specified consisted of acid-base titration of a 1:10 diluted liquor with 0.1 N sodium hydroxide, after removal of aluminum sulfate by 3% sodium oxalate, using methyl red as the indicator. The method found most suitable for the analysis of aluminum sulfate consisted of complexometric titration, using Trilon B, xylenol orange indicator, and zinc sulfate as the titrating agent. References 4 (Russian). [186-12172]

UDC 677.463.021.123.543

COMPOSITION OF HEMICELLULOSE DISSOLVED IN MERCERIZATION FLUID OF VISCOSE FACILITIES

Moscow KHIMICHESKIYE VOLOKNA in Russian No 5, Sep-Oct 85 (manuscript received 26 Jul 84) pp 31-32

IVANOVA, V.S., KIPERSHLAK, E.Z., PAKSHVER, A.B., USOV, A.I. and PEVZNER, N.V.

[Abstract] An analysis was conducted on the hemicellulose component of alkaline mercerization fluids obtained in the course of viscose production. The basic approach consisted of neutralization with cation-exchanger KU-2, filtration and evaporation, washing, ethanol precipitation and chromatographic analysis. Fraction I (insoluble) contained 11.3% of the total

polysaccharides and fraction II (soluble) 88.7%. Only xylose was identified in fraction I by paper chromatography, whereas fraction II contained xylose, mannose and glucose in a ratio of 1:1:0.5, as well as a small amount of arabinose. The polymerized component of fraction II had a MW slightly less than that of dextran T10 with a degree of polymerization = 60. Most of the carbonyl groups of the hemicellulose in fraction II were located in terminal positions of the molecules. Figures 2; references 6 (Russian). [186-12172].

## MISCELLANEOUS

BOOK: QUANTUM CHEMISTRY UNDER CONDITIONS OF DEEP COLD

Moscow KHIMIYA: KVANTOVAYA KHIMIYA V OBLASTI GLUBOKOGO KHOLODA in Russian  
No 10, Oct 85 pp 2-4

[Table of Contents, Annotation, and Introduction from brochure by  
V.I. Goldanskiy, "Quantum Chemistry in the Region of Deep Cold" in the  
monthly series "New in Life, Science and Technology: Popular Science  
Subscription Series," Izdatelstvo "Znaniye," 32 pages, 28,390 copies]

### [Text] TABLE OF CONTENTS

Introduction.....	3
Arrhenius' Law. Quantum Corrections to the Law.....	4
The Tunnel Effect. Examples from Nuclear Physics and Solid Body Physics.	10
Arrhenian and Tunnel Regions of Chemical Reaction Penetration. Tunnel- ing Temperature.....	12
Electron Tunneling. Redox and Biophysical Processes.....	14
Polymerization in the Solid Phase Near Absolute Zero. Molecular Tunneling and the Low-Temperature Quantum Limit for the Rate of Chemical Reaction.....	22
Cryochemical Reactions in Interstellar Space.....	27
Literature.....	32

### ANNOTATION

The brochure deals with one of the outstanding achievements of Soviet chemical physics--the discovery and study of the low-temperature quantum limit on the rate of chemical reactions. It has turned out that, despite the expectations of classical kinetics, the ability to react chemically is preserved even in direct proximity to absolute zero due to the so-called tunnel effect.

The publication is directed toward lecturers, instructors, and audiences of people's universities.

### INTRODUCTION

All natural sciences share a common feature: The laws which describe particular natural phenomena are gradually made more precise over time. Gradually does not mean quietly or without conflict. The theory of relativity,

which forced us to reconsider Newton's mechanics, which had been proven by the centuries, light quanta, which have replaced light waves, quantum mechanics itself with its "uncertainties"--these are all clear examples of how "dramas of ideas" are played out from time to time in science, and of how new revolutionary ideas require revision of old, tired concepts. Neither physics, chemistry, astronomy, biology, nor, in general, even one experimental science can claim that its arsenal of current knowledge is the absolute and final truth.

Each step in the study of nature is always one closer to the truth. More precise testing of laws or review of a wider field than that in which they were originally derived results in the discovery of phenomena whose existence was previously unsuspected. At the same time, the most revolutionary changes in scientific attitudes means not the nullification of old laws as incorrect, but only the recognition that they are incomplete.

However, there is a wide range of phenomena in the micro-world--the world of elementary particles and nuclei, atoms and molecules, the comprehension and quantification of which is on the whole based on the dualism of matter's corpuscular and wave properties and therefore requires use of quantum mechanics.

Quantum mechanics has not replaced Newtonian mechanics, which still describes the motion of an automobile or bullet and reliably serves for very precise predictions of lunar eclipses or satellite flight.

We must consider clarifying the laws of chemical kinetics and introduction, into this classical field of knowledge, of ideas and methods of quantum mechanics. It is precisely the principles of quantum mechanics which predicted and explained the existence and mechanism of chemical reactions in deep cold, at temperatures near absolute zero--reactions which simply cannot be, according to the laws of classical chemical kinetics.

Throughout its entire history, the science of chemistry has developed in close connection with physics. From a science studying the composition and structure of compounds, from the purely static, chemistry gradually became dynamic--a science studying the processes by which some substances are transformed into others. At the end of the 18th and the beginning of the 19th centuries, the concept of the time required for "chemical action," of the time in which a reaction takes place--the rate of chemical transformation, entered and assumed an important place in chemistry.

"If, as a result of some world catastrophe, all accumulated knowledge were destroyed, and surviving generations of living beings inherited only one phrase, only one of the laws established by mankind, then what scientific statement would provide the most information?" This is question not from a science fiction novel, but from lecturers for future physicists given by Nobel Laureate R. Fineman. It is possible that answers from representatives of different sciences would not match. But Fineman himself gave the answer (there is no doubt that both physicists and chemists would agree with him): the very quintessence of modern knowledge about nature is the "atomic hypothesis: All bodies consist of atoms, which are in unordered motion."

Collisions of atoms and molecules or excitation of molecules exposed to light under certain conditions result in chemical transformations which accompany all natural phenomena--from the formation of planets and eruption of volcanoes to the launching of a space ship and the ripening of an ear of corn.

Over the centuries, chemists have discovered that all substances known to us consist of simpler substances, chemical elements, which number more than a hundred in nature. Combining into molecules, the atoms of these elements form millions of different substances. While classical physics studies processes which do not violate the integrity of molecules, the subject of chemistry is the movement of atoms and molecules which leads to their new combination, to new substances with new properties.

One must assume that the primitive tribes froze meat won by hunters when they wanted to preserve the leftovers for a rainy day. In its everyday experience, mankind learned an indisputable truth: Chemical reactions slow down as temperature decreases. This apparently happened when people had no understanding whatsoever of the existence of chemical transformations or of the meaning of temperature.

The never-ending motion of atoms and molecules is not called thermal by accident, since its intensity is measured by temperature. The higher the temperature, the more energy the moving molecules have, the more often they collide, the higher the probability that they will restructure during collisions, etc., i.e., as temperature rises, chemical transformations become more intense. It is natural to expect a reverse relationship--a drop in temperatures will slow chemical reaction, so that, at absolute zero, any substance should become completely inert. Despite expectations, however, in the last 10-15 years it has been established that chemical reactions may in and of themselves occur even at temperatures near absolute zero.

The task has arisen to explain these surprising facts, to provide a theoretical description for the mechanism and rate of chemical reactions for conditions of deep cold. It is precisely these tasks which have required review of the classical laws of chemistry--more precisely, their serious expansion--and correlation of traditional conceptions based on the universal codex of the microworld--quantum mechanics.

Jumping ahead, we will say that cryochemical (from the Greek *kyros*--cold) reactions near absolute zero are a result of a phenomenon purely quantum in origin--the tunnel effect. This factor--quantum tunneling--makes our Sun capable to supplying the Earth with heat and light.

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SIMULTANEOUS ACTION OF TWO ACOUSTICAL OSCILLATION FREQUENCIES ON RATE OF ACOUSTICOCHEMICAL REACTIONS

Moscow ZHURNAL FIZICHESKOY KHIMII in Russian Vol 59, No 10, Oct 85 (manuscript received 10 Oct 84) pp 2620-2623

DMITRIYEVA, A.F. and MARGULIS, M.A., All-Union Scientific Research Institute of Organic Synthesis, Moscow

[Abstract] A study is presented of the simultaneous influence of two frequencies on acousticochemical reactions in water and aqueous solutions. The formation of  $H_2O_2$  and  $HNO_2$  in water and  $I_2$  in 0.3 M KI solution was studied with exposure to ultrasound at 20 KHz, 1 MHz and with simultaneous exposure to both frequencies. The use of the two-frequency method was found to suppress liberation of  $I_2$  in comparison to sonolysis at the higher frequency alone. The decrease in rate of formation of  $I_2$  with both frequencies (also observed for  $NO_2^-$ ) and the increase in the effectiveness of emulsification, dispersion and purification are apparently results of the specifics of development and interaction of cavitation bubbles when both frequencies are present. Figures 4; references 10: 4 Russian, 6 Western. [220-6508]

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END